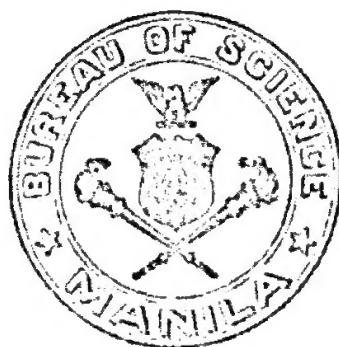


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THE PHILIPPINE JOURNAL OF SCIENCE

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ADDITIONS TO OUR KNOWLEDGE OF THE PHILIPPINE FLORA, III¹

By ELMER D. MERRILL

Of the University of California, Berkeley

This, the third paper of the series, lists forty-seven species as new to the flora of the Philippines, including thirty-two which are herein described as new. One new name and two transfers are also published for the first time. Eight previously described genera are recorded for the first time from the Archipelago; namely, *Koordersiochloa*, *Baphia*, *Fordia*, *Merope*, *Xanthomyrtus*, *Anplectrum*, *Peucedanum*, and *Zanonia*.

The bulk of the species considered in this paper are from the extensive collections made by Messrs. Ramos and Edaña in Jolo and Tawitawi, Sulu Archipelago, in 1924. Neither island had previously been explored botanically, only casual collections having been made in this region. As usual in cases of this kind, where extensive collections are made for the first time in a previously unexplored region, the number of forms of special interest and value is great. From the proximity of the Sulu Archipelago to Borneo, as naturally would be expected, a fair number of the additions represent Bornean types or forms allied to Bornean species.

The actual types are deposited in the Bureau of Science herbarium, with duplicates in the herbarium of the University of California. Remaining duplicates will be distributed to other botanical institutions.

¹ Additions to our knowledge of the Philippine Flora. I, *Philip. Journ. Sci.* 26 (1925) 447-496; II, 29 (1926) 475-496.

GRAMINEÆ

Genus *KOORDERSIOCHLOA* Merrill*Koordersiochloa javanica* Merr.

Koordersiochloa javanica MERR. in Philip. Journ. Sci. 12 (1917) Bot. 67, t. 1.

LUZON, Benguet Subprovince, Mount Pulog, *Bur. Sci.* 44923 *Ramos and Edaño*, February, 1925, in the mossy forest, altitude about 2,400 meters.

A wholly unexpected addition to the list of Philippine genera; the genus is monotypic and hitherto was known only from the higher mountains of Java. One other monotypic genus of this family *Asthenochloa* (*Garnotiella*), has the same restricted distribution. Prof. A. S. Hitchcock has kindly compared the Philippine material with a part of the type collection of *Koordersiochloa javanica* Merr. in the United States National Herbarium and states that it is exactly the same as the Javan form.

LILIACEÆ

Genus *PLEOMELE* Salisbury*Pleomele bangueyensis* Merr.

Pleomele bangueyensis MERR. in Philip. Journ. Sci. 29 (1926) 355.

TAWITAWI, Sulu Archipelago, *Bur. Sci.* 44151, 44292 *Ramos and Edaño*, August, 1924. BIGAWAYAN, Calamian group, *Bur. Sci.* 41294 *Ramos*, all specimens in fruit.

The specimens cited all appear to be referable to the species recently described by me from Banguey Island, just off the north-eastern coast of Borneo. In thickets and forests at low altitudes.

ZINGIBERACEÆ

Genus *AMOMUM* Linnæus*Amomum havilandii* K. Schum.

Amomum havilandii K. SCHUM. in Engl. Bot. Jahrb. 27 (1899) 303.

Hornstedtia havilandii K. SCHUM. in Pflanzenreich 20 (1904) 193.

JOLO, Sulu Archipelago, *Bur. Sci.* 44454 *Ramos and Edaño*, September, 1924, in second-growth forests at low altitudes. Borneo.

The specimen closely matches *Elmer* 20088 from British North Borneo which I originally identified as *Hornstedtia scyphifera* Steud., but which I now believe to represent K. Schumann's species.

Genus *BOESENBERGIA* O. Kuntze*Boesenbergia macropoda* sp. nov.

Herba erecta, glabra, circiter 60 cm alta, caulis 15 ad 18 cm longis; foliis 3 vel 4, membranaceis, oblongo-ellipticis, acuminatis, 20 ad 30 cm longis, 9 ad 11 cm latis, longissime (15 ad 20 cm) petiolatis; spicis paucifloris, in vaginis superioribus inclusis; floribus circiter 8 cm longis, corollae tubo tenue, ad 6.5 cm longo, lobis lanceolatis, acuminatis, membranaceis, 1.8 ad 2 cm longis, labellum circiter 2.5 cm longum et 1.5 ad 2 cm latum.

An erect glabrous herb about 60 cm high, the stems 15 to 18 cm long, entirely concealed by the imbricating sheaths, the lower sheath 3 to 4 cm long, the next about 7 cm long, the third about 15 cm long, lax, thin, all leafless. Leaves 3 or 4, greenish olivaceous, membranaceous, oblong-elliptic, sharply and shortly acuminate, 20 to 30 cm long, 9 to 11 cm wide, base more or less decurrent, midrib prominent, nerves slender, oblique; petioles 15 to 20 cm long. Spikes few-flowered, included in the upper sheath, a single flower opening at one time. Flowers red and pink, about 8 cm long, the calyx slender, the corolla tube slender, about 6.5 cm long, the lobes lanceolate, membranaceous, somewhat acuminate, 1.8 to 2 cm long, 3.5 to 4 mm wide. Labellum about 2.5 cm long and 1.5 to 2 cm wide. Anther oblong, about 7 mm in length.

JOLO, Sulu Archipelago, *Bur. Sci.* 44394 Ramos and Edaño, September, 1924, near cultivated areas at low altitudes, known to the Joloanos as *tamlang*.

The second species of the genus to be found in the Philippines, apparently allied to the Javan *Boesenbergia javana* (K. Schum.) Schltr. (*Gastrochilus javanum* K. Schum.) of Java. It is very different from the single species hitherto known from the Philippines (southwestern Mindanao), *B. longipetiolata* (Ridl.) Merr.

LORANTHACEÆ

Genus *LORANTHUS* Linnæus*Loranthus cordilimbus* sp. nov. § *Dendrophthoe*.

Frutex parasiticus, inflorescentiis exceptis glaber, ramis ramulisque teretibus, ramulis circiter 3 mm diametro; foliis oppositis, coriaceis, subsessilibus, oblongo-ovatis ad ovato-lanceolatis, coriaceis, 8 ad 15 cm longis, 3 ad 8 cm latis, apice perspicue acuminatis, basi late rotundatis, distincte cordatis, nervis primariis

utrinque circiter obscuris, plerumque subobsoletis, petiolo crasso, 2 ad 4 mm longo; inflorescentiis terminalibus, circiter 10 cm longis, multifloris, floribus 6-meris, puberulis, 12 ad 15 mm longis, in triadibus racemose dispositis.

A parasitic shrub, glabrous except the inflorescences, the branches and branchlets terete, smooth, the latter about 3 mm in diameter. Leaves opposite, very shortly petiolate, coriaceous, rigid, oblong-ovate to ovate-lanceolate, 8 to 15 cm long, 3 to 8 cm wide, narrowed upward to the conspicuously and sharply acuminate apex, the base broad, abruptly rounded and distinctly cordate; lateral nerves slender, obscure, at most 7 on each side of the midrib, which is very prominent on the lower surface, often obsolete or nearly so; petioles stout, 2 to 4 mm long. Inflorescences terminal, about 10 cm long, many-flowered, somewhat furfuraceous, the flowers uniformly puberulent. Primary branches (triads) racemously disposed, the branchlets 4 to 5 mm long, the bract of the sessile flower ovate to oblong-ovate, acuminate to acute, about 4 mm long, those of the pedicelled flowers somewhat smaller, the pedicels of the lateral flowers in each triad 3 to 3.5 mm long. Flowers (not quite mature) 6-merous, 12 to 15 mm long, puberulent, the calyx cylindric, 2.5 to 3 mm long, truncate, the corollas slightly inflated below, then narrowed, and expanding again at the tips (in bud), the anthers 2.5 mm long.

SAMAR, Loquilocon, *Bur. Sci.* 43873 *McGregor*, June, 1924, without notes, but probably from an altitude of about 250 meters, in forests.

Among the Philippine species perhaps as closely allied to *Loranthus saccatus* Elm. as any other species, but differing in its puberulent flowers and in its more prominently cordate, nearly sessile leaves.

ANONACEÆ

Genus PSEUDUVARIA Miquel

Pseuduvaria macgregorii sp. nov.

Arbor parva, circiter 3 m alta, dioica, ramulis pubescentibus; foliis chartaceis, oblongo-ovatis ad late oblongo-ob lanceolatis, acuminatis, basi obtusis ad acutis, plerumque leviter inaequilateralibus, 15 ad 30 cm longis, 6 ad 12 cm latis, nervis primariis utrinque circiter 16, perspicuis; floribus ♂ axillaribus, plerumque in axillis defoliatis, fasciculatis, circiter 1 cm diametro, pedicellis circiter 1 cm longis; petalis exterioribus late ovatis, extus leviter pubescentibus, tenuiter nervosis, circiter 3 mm longis, obtusis, interioribus quam exterioribus crassioribus, sub-

rhomboideis, circiter 5 mm longis, subacutis, deorsum angustatis; staminibus 30 ad 35; fructibus obovoideis ad globosis, 1.5 ad 2 cm diametro, glabris vel subglabris, perspicue grosse irregulariter foveolatis; seminibus 2, plano-convexis, 10 ad 12 mm diametro.

A small dioecious tree, about 3 m high, the older branches nearly glabrous, the younger ones rather densely pubescent. Leaves chartaceous, olivaceous, oblong-ovate to broadly oblong-ob lanceolate, 15 to 30 cm long, 6 to 12 cm wide, acuminate, base obtuse to acute, usually somewhat inequilateral, the upper surface glabrous or the midrib pubescent, the lower surface sparingly pubescent on the midrib and nerves; lateral nerves about 16 on each side of the midrib, conspicuous, obscurely arched-anastomosing, the reticulations slender; petioles stout, pubescent, 5 to 9 mm long. Flowers fascicled, axillary, and chiefly from the axils of fallen leaves, about 1 cm in diameter, their pedicels slender, somewhat pubescent, about 1 cm long, with a single broadly ovate bracteole about 1.5 mm long at the upper two-thirds. Sepals broadly ovate, acute, somewhat pubescent, 1.2 mm long. Outer petals flat, broadly ovate, slenderly 5- to 7-nerved, somewhat pubescent externally, obtuse, about 3 mm long; inner petals black when dry, much thicker than the outer ones, somewhat pubescent externally, subrhomboid, acute, the apical part often involute, narrowed below, but not clawed, about 5 mm long. Stamens 30 to 35, about 0.6 mm long, often wider than long. Pistillate flowers not seen. Fruits globose to obovoid, glabrous or nearly so, 1.5 to 2 cm in diameter, the pericarp irregularly longitudinally 7-keeled, or ridged, irregularly and coarsely foveolate, nearly black when dry; seeds two, plano-convex, 10 to 12 mm in diameter, the albumen ruminant.

SAMAR, Loquilocon, *Bur. Sci.* 43714 (type), 43752 McGregor, June, 1924, flowers pale yellow, altitude about 250 meters, apparently in primary forests.

A species distinguished from its Philippine congeners in this small genus by its larger, more numerous nerved leaves. The peculiarly ridged and coarsely and irregularly foveolate fruits are characteristic.

Genus GONIOTHALAMUS Hooker f. and Thomson

Goniotalamus suluensis sp. nov.

Arbor parva, circiter 7 m alta, floribus parce pubescentibus exceptis glabra ramulis teretibus, 2.5 ad 4 mm diametro; foliis magnis, chartaceis, late oblongis, 35 ad 48 cm longis, 11 ad 16

cm latis, in siccitate pallide olivaceis, nitidis, apice abrupte obtuseque acuminatis, basi late acutis, nervis primariis utrinque circiter 18, tenuibus; floribus axillaribus, solitariis, circiter 7 cm longis, sepalis ovatis ad oblongo-ovatis, acutis, circiter 1.5 cm longis, glabris vel subglabris; petalis exterioribus lanceolatis, tenuiter acuminatis, leviter pubescentibus, 7 cm longis, 1.5 cm latis, interioribus sepalis subaequantibus, oblongo-ovatis, acutis, extus plus minusve adpresse hirsutis; fructibus junioribus ellipsoideis ad subobovoides, glabris, circiter 8 mm longis.

A small tree about 7 m high, nearly glabrous, the branches and branchlets terete, dark-colored when dry, the latter 2.5 to 4 mm in diameter. Leaves chartaceous, broadly oblong, pale olivaceous and shining when dry, 35 to 48 cm long, 11 to 16 cm wide, the apex abruptly and obtusely acuminate, the acumen stout, up to 1.5 cm long, base broadly acute; lateral nerves about 18 on each side of the midrib, slender, arched-anastomosing, the reticulations lax, not prominent; petioles stout, 1.5 to 2 cm long. Flowers axillary, solitary, about 7 cm long, the pedicels about 1.4 cm long, glabrous or nearly so. Sepals ovate to oblong-ovate, acute, about 1.5 cm long, glabrous or nearly so. Outer petals lanceolate, sparingly appressed-pubescent; slenderly acuminate, subcoriaceous, rather brittle when dry, 7 cm long, 1.5 cm wide. Inner petals about as long as the sepals, coriaceous, oblong-ovate, acute, outside more or less appressed-hirsute with ferruginous hairs, the margins densely pale-pubescent, glabrous or nearly so inside. Carpels numerous. Young fruits glabrous, ellipsoid to subobovoid, black when dry, about 8 mm long.

TAWITAWI, Sulu Archipelago, *Bur. Sci.* 44350 Ramos and Edaño, August, 1924, along Malum River near mangrove swamps. Locally known to the Joloanos as *nunang*.

A species in its very large leaves approaching *Goniothalamus gigantifolius* Merr., but with entirely different venation, much fewer, very much less conspicuous nerves, and entirely different fruits.

MYRISTICACEÆ

Genus *KNEMA* Loureiro

Knema insularis sp. nov.

Arbor circiter 1 m alta, ramulis tenuibus, dense breviter ferrugineo-pubescentibus; foliis anguste oblongis, firmiter chartaceis ad subcoriaceis, 14 ad 22 cm longis, 3 ad 6 cm latis, breviter acuminatis, basi late acutis ad subrotundatis, supra glaberrimis, nitidis, pallide olivaceo-viridibus, subtus glaucis, glabris vel

deorsum ad costa nervisque dense substellato-tomentosis; nervis lateralibus utrinque 20 ad 26, subtus perspicuis, petiolo 5 ad 10 mm longo; floribus ♂ axillaribus et in axillis defoliatis, circiter 9 mm diametro, extus dense ferrugineo-pubescentibus, intus glabris, pedicellis floribus subaequantibus; disco stamineo haud mamillato, circiter 3 mm diametro, antheris 18 ferentibus.

A tree about 7 m high, the branches terete, glabrous, rugose when dry, the branchlets slender, densely ferruginous-pubescent with short hairs. Leaves narrowly oblong, firmly chartaceous to subcoriaceous, 14 to 22 cm long, 3 to 6 cm wide, apex shortly acuminate, base broadly acute to somewhat rounded, the upper surface pale greenish olivaceous when dry, shining, glabrous, the lower surface glaucous, glabrous, or the midrib in the lower part and the lower nerves more or less densely pubescent with short ferruginous hairs; lateral nerves 20 to 26 on each side of the midrib, prominent, curved-anastomosing, the primary reticulations slender, subparallel; petioles densely ferruginous-pubescent, becoming glabrous, 5 to 10 mm long. Staminate flowers axillary and in the axils of fallen leaves, fascicled on short stout tubercles, red-brown when dry, about 9 mm in diameter, their ferruginous-pubescent pedicels not longer than the flowers. Perianth segments broadly ovate, rounded, about 4.5 mm long, pubescent externally, glabrous within. Staminal disk not umbonate, about 3 mm in diameter, bearing on its margin about 18 anthers, the latter about 0.5 mm in length.

TAWITAWI, Sulu Archipelago, *Bur. Sci.* 44288 *Ramos and Edaño*, July, 1924, in damp forests at low altitudes.

A species characterized by its relatively large staminate flowers and manifestly closely allied to the Bornean *Knema korthalsii* Warb., differing in its smaller leaves and its more-numerous anthers.

ROSACEÆ

Genus PYGEUM Gaertner

Pygeum subglabrum sp. nov.

Arbor parva, circiter 3 m alta, subglabra, ramis ramulisque glabris vel ramulis junioribus parcissime pubescentibus; foliis crasse coriaceis, rigidis, ellipticis, late acutis vel obscure brevissime acuminatis, basi late acutis ad subrotundatis, subtus biglandulosis, junioribus parcissime pubescentibus, vetustioribus glaberrimis, 6 ad 8 cm longis, 3.5 ad 5 cm latis, nervis primariis utrinque circiter 7, perspicuis, petiolo crasso, 8 ad 14 mm longo; inflorescentiis lateralibus, e axillis defoliatis, plus

minusve ferrugineo-pubescentibus, ut videtur paucifloris, sub fructu circiter 3 cm longis; fructibus globosis, circiter 2 cm diametro, glabris, seminibus glabris.

A small tree about 3 m high, nearly glabrous, the branches and branchlets dark-colored when dry, glabrous or the very young branchlets slightly pubescent. Leaves thickly coriaceous, rigid, elliptic, 6 to 8 cm long, 3.5 to 5 cm wide, olivaceous when dry, the lower surface somewhat brownish, apex broadly acute or obscurely and shortly acuminate, base broadly acute to somewhat rounded, usually biglandular beneath, sometimes with but a single gland or glandless, the glands plane or somewhat impressed, although scarcely projecting on the upper surface, the younger leaves very sparingly pubescent, the mature ones entirely glabrous; lateral nerves 7 on each side of the midrib, prominent, the reticulations lax, rather indistinct; petioles glabrous, thick, 8 to 14 mm long. Inflorescences from the branches below the leaves, few, apparently few-flowered, more or less ferruginous-pubescent, in fruit about 3 cm long. Fruit (not mature) red when fresh, nearly black when dry, globose, glabrous, about 2 cm in diameter, the stout pedicels 3 to 4 mm long, glabrous inside as are the immature seeds.

LUZON, Benguet Subprovince, Mount Pulog, *Bur. Sci.* 45014 *Ramos and Edaño*, February 27, 1925, in the mossy forest at an altitude of about 2,700 meters.

A species well characterized by its thickly coriaceous, rigid, comparatively small leaves, its unusually large fruits, short infructescences, and in being nearly glabrous throughout except for the scattered hairs on the young parts and on the inflorescence. It is probably most closely allied to *Pygeum monticolum* Merr.

LEGUMINOSÆ

Genus BAPHIA de Candolle

Baphia borneensis Oliver.

Baphia borneensis OLIVER in Hook. Ic. IV 5 (1896) t. 2456; LESTER-GARLAND in Journ. Linn. Soc. Bot. 45 (1921) 239.

TAWITAWI, Sulu Archipelgo, *Bur. Sci.* 43964, 44153 *Ramos and Edaño*, August, 1924, in forests at low altitudes.

The genus is new to the Philippines, the species common in northern Borneo. Of the fifty-eight known species of the genus one occurs in Madagascar, the one here enumerated in Borneo and the Sulu Archipelago, and all the others are confined to Africa and mainly to the tropical parts of that continent.

Genus **FORDIA** Hemsley*Fordia brachybotrys* sp. nov.

Arbor parva, inflorescentiis leviter pubescentibus exceptis glabra, ramulis teretibus, 3 ad 4 mm diametro; foliis 30 ad 45 cm longis, 5-foliolatis, foliolis chartaceis, oblongis ad ellipticis vel oblongo-obovatis, 12 ad 24 cm longis, 6 ad 12 cm latis, basi acutis ad rotundatis, apice abrupte acuminatis, acuminis usque ad 2 cm longis, obtusis, nervis lateralibus 7 ad 9, tenuibus, distinctis, petiolulis 8 ad 10 mm longis; racemis solitariis vel fasciculatis, 6 ad 8 cm longis, caulinis vel e ramis vetustioribus, leviter pubescentibus, multifloris; floribus albido-purpureis, circiter 1.4 cm longis; leguminis oblique oblanceolatis, usque ad 16 cm longis, sursum usque ad 3.5 cm latis, deorsum angustatis, apice rostratis, valvis glabris, sublignosis vel crassissime coriaceis; seminibus 2 vel 3, compressis, circiter 1.2 cm diametro.

A small tree, glabrous except the sparingly pubescent cauline racemes. Branchlets slender, terete, glabrous, 3 to 4 mm in diameter. Leaves 30 to 45 cm long, 5-foliolate, the leaflets chartaceous, subolivaceous, somewhat paler beneath, shining on both surfaces, oblong to elliptic or oblong-obovate, 12 to 24 cm long, 6 to 12 cm wide, base acute to rounded, apex abruptly acuminate, the acumen up to 2 cm long, obtuse; lateral nerves 7 to 9 on each side of the midrib, slender, distinct, curved-anastomosing; petiolules 8 to 10 mm long, not stipellate. Racemes solitary or fascicled on the trunks and larger branches, sparingly appressed-pubescent, 6 to 8 mm long, many-flowered. Flowers purplish white, about 1.4 cm long, their pedicels 2.5 to 5 mm long. Calyx cup-shaped, truncate, about 5 mm long, bibracteolate at the base, the bracteoles elliptic, obtuse, about 1 mm long. Exposed parts of the petals appressed-pubescent with short hairs, the standard suborbicular-ovate, retuse, base truncate, about 12 mm in diameter, the claw 2 mm long or less; wings with 3 mm long claws, the limbs oblong, obtuse, about 11 mm long, 3.5 to 4 mm wide; keel petals similar to the wings. Ovary narrow, appressed-pubescent. Pod obliquely oblanceolate, up to 16 cm long, and 3.5 cm wide, flat, the valves almost woody, at least very thickly coriaceous, gradually narrowed from near the apex to the cuneate base, brown when dry, the apex oblique and with a conspicuous stout, more or less curved beak from the inner (seed-bearing) suture. Seeds 2 or 3, in the upper broader one-third of the pod only, compressed, almost circular in outline, about 12 mm in diameter.

TAWITAWI, Sulu Archipelago, *Bur. Sci.* 44277 Ramos and Edaño, July, 1924, in damp forests at low altitudes.

The first representative of the genus *Fordia* to be found in the Philippines, although it is very doubtful whether the group should be retained as of generic rank distinct from *Millettia*; practically the only constant distinguishing character appears to be the cauline inflorescences in *Fordia* as contrasted to the axillary ones of *Millettia*. The genus *Fordia* as at present constituted is represented by perhaps eight known species, extending from southeastern China to the Malay Peninsula, Sumatra, and Borneo. The present species is strongly characterized by its unusually broad leaflets.

Genus *MILLETTIA* Wight and Arnott

Millettia tenuipes sp. nov.

Frutex subglaber, ramis ramulisque teretibus, laevis, in siccitate brunneis, vix lenticellatis; foliis 5- vel 7-foliolatis, circiter 30 cm longis, glaberrimis, foliolis chartaceis vel submembranaceis, in siccitate subolivaceo-viridibus, nitidis, oblongo-ovatis ad oblongis, breviter acuminatis, basi plerumque rotundatis, 9 ad 14 cm longis, 3 ad 5 cm latis, nervis primariis utrinque circiter 7, tenuibus, distinctis, petiolulis circiter 7 mm longis, in siccitate nigris, estipellatis, racemis axillaribus, 12 ad 25 cm longis, pedunculatis, floribus circiter 2.5 cm longis, longissime (3 ad 4 cm) tenuiter pedicellatis, roseo-purpureis, calycis late cupulatis, parvis adpresse pubescentibus, petalis extus in partibus superioribus plus minusve ferrugineo-pubescentibus, ovario leviter ciliato-hirsuto, sursum glabrescens.

An erect, nearly glabrous shrub, the branches and branchlets terete, slender, smooth, scarcely lenticellate, dark brown when dry, the very young parts sometimes with a few scattered hairs. Leaves about 30 cm long, the leaflets 5 or 7, oblong-ovate to oblong, 9 to 14 cm long, 3 to 5 cm wide, shortly acuminate, base rounded, entirely glabrous, subolivaceous greenish when dry, shining; lateral nerves about 7 on each side of the midrib, slender, distinct, arched, scarcely anastomosing or if so then very close to the margin; stipels none; petiolules black when dry, about 7 mm long. Racemes axillary, slender, 12 to 25 cm long, flower-bearing mostly in the upper one-half, the flowers comparatively few, not more than 25 to a raceme, about 2.5 cm long, pinkish purple, their slender pedicels 3 to 4 cm long. Calyx broadly cup-shaped, subtruncate, castaneous when dry, sparingly pubescent externally with short appressed hairs, the

margins more densely pubescent. Petals in bud (exposed portions) rather densely appressed subferruginous-pubescent, in anthesis the indumentum more or less scattered and largely confined to the upper parts. Staminal sheath glabrous. Ovary more or less ciliate hirsute below, glabrous or nearly so above.

LUZON, Zambales Province, Mount Marayep, *Bur. Sci.* 44803 Ramos and Edaño, December 12, 1924, along forested streams at low altitudes.

A species remarkable for its unusually large flowers and their slender, greatly elongated pedicels which attain a length of 4 cm. The species is apparently a very ornamental one and one well worthy of cultivation. It differs from all the hitherto described Philippine forms especially in its long pedicels and large flowers.

Genus INTSIA Thouars

Intsia retusa (Kurz) O. Kuntze.

Intsia retusa (Kurz) O. KUNTZE, *Rev. Gen. Pl.* (1891) 192.

Afzelia retusa KURZ in *Journ. As. Soc. Bengal* 42¹ (1873) 73; Prain ex KING, *Journ. As. Soc. Bengal* 66¹ (1897) 207; RIDL., *Fl. Mal. Penin.* 1 (1922) 639.

TAWITAWI, Sulu Archipelago, *Bur. Sci.* 44348 Ramos and Edaño, August, 1924, along Malum River in tidal swamps. In similar habitats from the Gangetic delta to Singapore and Borneo.

The specimens are in fruit and conform very closely with the descriptions except that the pods, described as 5 to 6 inches long and 2 inches wide, are 7 inches long and vary from 2 to 2.5 inches in width.

RUTACEÆ

Genus MEROPE M. Roemer

Merope angulata (Willd.) Swingle.

Merope angulata (Willd.) SWINGLE in *Journ. Wash. Acad. Sci.* 5 (1915) 423.

Citrus angulata WILLD., *Sp. Pl.* 3 (1800) 1426.

Sclerostylus spinosa BLUME, *Bijdr.* (1825) 134.

Atalantia longispina KURZ in *Journ. As. Soc. Bengal* 41¹ (1872) 295.

Gonocitrus angulatus KURZ, *Journ. As. Soc. Bengal* 42² (1847) 223, t. 18.

Paramignya angulata KURZ, *Journ. As. Soc. Bengal* 43¹ (1874) 135;

VALETON in *Ic. Bogor.* 4 (1912) 159, t. 348.

TAWITAWI, Sulu Archipelago, *Bur. Sci.* 44341 Ramos and Edaño, July, 1924. In mangrove forests, local name *balimbing-balimbingan*.

A monotypic genus new to the Philippines. For additional synonyms see Swingle² and Merrill.³ India, through Malaysia to the Moluccas.

Genus **GLYCOSMIS** Correa

Glycosmis elmeri sp. nov.

Frutex circiter 1 m altus, partibus junioribus inflorescentiisque parvis pubescentibus exceptis glaber, ramulis viridibus; foliis 3- vel 4-foliolatis 30 ad 40 cm longis, foliolis glaberrimis vel junioribus subtus parvis pubescentibus, oblongo-ellipticis, chartaceis, in siccitate pallidis, nitidis, apice acuminatis, basi late acutis, 15 ad 30 cm longis, 7 ad 13 cm latis, nervis primariis utrinque 9 ad 11, distantibus, arcuato-anastomosantibus, subtus valde perspicuis; inflorescentiis terminalibus, pedunculatis, paniculatis, circiter 6 cm longis, ramis primariis paucis, patulis, 2 ad 3 cm longis; floribus 5-meris, glabris.

A shrub about 1 m high, entirely glabrous except for the obscure, rufous or castaneous, scattered hairs on the youngest parts and inflorescences, the branches smooth, terete, pale, shining, the branchlets greenish. Leaves 3- or 4-foliolate, 30 to 40 cm long, chartaceous, shining when dry, the upper surface pale olivaceous, the lower much paler than the upper, oblong-elliptic, 15 to 30 cm long, 7 to 13 cm wide, apex acuminate, the acumen usually blunt, the base broadly acute; lateral nerves 9 to 11 on each side of the midrib, distant, usually somewhat impressed on the upper surface, very prominent beneath, arched-anastomosing, the reticulations lax; petiolules about 5 mm long, the petioles and rachis 10 to 14 cm long, greenish. Inflorescences terminal, peduncled, paniculate, rather few-flowered, about 6 cm long, the peduncles as long as the flower-bearing parts, the primary branches few, spreading, 2 to 3 cm long, obscurely pubescent, some parts entirely glabrous. Flowers white, 5-merous, sessile, the sepals coriaceous, elliptic, rounded, about 1.2 mm long, their margins thin, slightly pubescent. Petals about 3 mm long, glabrous. Stamens 10. Ovary and style glabrous.

TAWITAWI, Sulu Archipelago, *Bur. Sci.* 44150 Ramos and Edaña, August 5, 1924, along small streams in damp forests at low altitudes.

² Journ. Wash. Acad. Sci. 5 (1915) 423.

³ Interp. Rumph. Herb. Amb. (1917) 294.

A species characterized by its very large, pale, conspicuously nerved leaflets, apparently most closely allied to *Glycosmis platyphylla* Merr., from which it differs in its larger, more numerous nerved leaflets and shorter inflorescences. The same species is represented by *Elmer* 20186, 20442 from British North Borneo.

DICHAPETALACEÆ

Genus DICHAPETALUM Thouars

Dichapetalum platyphyllum sp. nov.

Frutex ut videtur erectus, circiter 1 m altus, subglaber, ramis glabris, ramulis leviter pubescentibus; foliis ellipticis ad oblongo-ellipticis, chartaceis, in siccitate nitidis, supra subolivaceis, glaberrimis, subtus pallidioribus secus costa nervisque leviter adpresse pubescentibus glabrescentibus, apice breviter acuminatis, basi cuneatis vel acutis, 17 ad 22 cm longis, 7 ad 12 cm latis, nervis primariis utrinque 7 ad 9, curvato-adscendentibus, distantibus, perspicuis; inflorescentiis cymosis, axillaribus, ut videtur paucifloris, 2 ad 3 cm longis, leviter adpresse pubescentibus, sepalis persistentibus, ellipticis ad oblongo-ellipticis, circiter 3 mm longis; fructibus obovoideis, 2- vel 3-locellatis, 10 ad 12 mm longis, dense ferrugineo-pubescentibus.

Apparently an erect shrub about 1 m high, the branches glabrous, somewhat yellowish brown when dry, the branchlets sparingly appressed-pubescent. Leaves chartaceous, elliptic to oblong-elliptic, 17 to 22 cm long, 7 to 12 cm wide, shining, the upper surface subolivaceous, glabrous throughout, the lower surface paler and with few to rather many, pale, short, appressed hairs along the midrib and lateral nerves, ultimately becoming glabrous, the apex shortly acuminate, base cuneate to acute, sometimes somewhat decurrent acuminate; lateral nerves 7 to 9 on each side of the midrib, prominent, distant, curved-ascending, anastomosing rather close to the margins, the reticulations slender, distinct; petioles 1 to 1.5 cm long, slightly pubescent, rugose. Cymes axillary, apparently few-flowered, 2 to 3 cm long, more or less appressed pubescent with short subferruginous hairs. Flowers unknown, but the persistent sepals oblong to elliptic, rounded, somewhat pubescent, about 3 mm long. Fruits obovoid, when nearly mature about 12 mm long, densely ferruginous-pubescent with short hairs, 2- or 3-celled, the apex often somewhat retuse, the pericarp 2 to 3 mm thick.

TAWITAWI, Sulu Archipelago, *Bur. Sci.* 44045 Ramos and Edaño, July, 1924, in damp forests at low altitudes.

A species well characterized by its relatively large and broad leaves, and in being glabrous or nearly so, except for the inflorescences, the slightly pubescent branchlets, and the rather peculiar appressed hairs along the midrib and lateral nerves on the lower surface of the younger leaves.

EUPHORBIACEÆ

Genus *MALLOTUS* Loureiro

Mallotus moritzianus Muell.-Arg.

Mallotus moritzianus MUELL-ARG. in DC. Prodr. 15: (1866) 971; PAX and HOFFM. in Pflanzenreich 63 (1914) 152.

TAWITAWI, Sulu Archipelago, *Bur. Sci.* 44325 Ramos and Edaña, August, 1924, in damp forests at low altitudes.

The specimens have larger leaves than does the typical Javan form, the largest ones being 30 cm long and 20 cm wide. They are distinctly caudate-acuminate, with shorter petioles, and are less conspicuously glandular than the type, while the venation approaches the pinnate type of *Hancea* and *Arenfeldia* rather more closely than it does the palmate or 3-nerved type of *Echinocroton*. Additional material may show that it is desirable to separate the Philippine form from the Javan one. Java and Borneo.

Genus *PHYLLANTHUS* Linnæus

Phyllanthus lancilimbus sp. nov.

Frutex glaber, dioicus, ramis teretibus, 3 ad 4 mm diametro, ramulis numerosis, confertis, usque ad 20 cm longis, tenuibus, circiter 1 mm diametro, angulatis vel anguste alatis; foliis numerosis lanceolatis, pallidis, subfalcatis, utrinque subaequaliter angustatis, chartaceis, utrinque acuminatis, 3 ad 6 cm longis, 4 ad 8 mm latis, nervis primariis utrinque 8 ad 10, tenuibus, patulis, indistinctis, arcuato-anastomosantibus; floribus ♂ axillaribus, fasciculatis, pedicellis usque ad 5 mm longis, perianthi segmentis 6, oblongis, obtusis, 2 mm longis; staminibus 3, filamentis liberis, ad 1 mm longis, antheris continuis, oblongis, 0.5 mm longis, extrorse longitudinaliter dehiscentibus.

A glabrous dioecious shrub, the branches terete, reddish brown to pale brown, 3 to 4 mm in diameter, bearing numerous, somewhat crowded ultimate branchlets, these slender, 10 to 20 cm long, about 1 mm in diameter, pale when dry, angled or narrowly winged, although toward the base often subterete, the branchlets subtended by several ovate to lanceolate, rather rigid, acuminate stipulelike bracts up to 4 mm in length. Leaves

numerous, pale, chartaceous, lanceolate, subfalcate, subequally narrowed to the cuneate base and the acuminate apex, the acumen often obtuse; lateral nerves slender, not prominent, spreading, 8 to 10 on each side of the midrib, arched-anastomosing, reticulations relatively lax, obscure; petioles 1 to 2 mm long; stipules about 1 mm long, suborbicular, inequilateral, often slightly concave, rounded, about 1 mm long. Staminate flowers numerous, axillary, fascicled, their pedicels up to 5 mm long. Perianth segments 6, subequal, oblong, obtuse, 2 mm long, apparently pale green. Stamens 3, their filaments free, rather stout, up to 1 mm long, the anthers continuous, oblong, extrorse, longitudinally dehiscent. Disk glands reniform-orbicular, about 0.2 mm long.

SAMAR, Loquilocon, *Bur. Sci.* 43876 McGregor, June, 1924, without notes except as to altitude which is indicated as about 250 meters.

The branchlets simulate pinnate leaves, as in many other species of this perplexing genus. The species is apparently remote from any of the hitherto described Philippine forms, being well characterized by its numerous, pale, lanceolate, slightly falcate, obscurely nerved leaves.

Phyllanthus caudatifolius sp. nov.

Frutex vel arbor parva, dioica, glabra, ramis teretibus, pallidis, ramulis tenuibus, elongatis, usque ad 35 cm longis, teretibus, 1 ad 1.5 mm diametro; foliis paucis, lanceolatis, chartaceis ad submembranaceis, 7 ad 14 cm longis, 1 ad 2.5 cm latis, basi acutis, apice tenuiter caudato-acuminatis, in siccitate supra olivaceis vel brunneo-olivaceis, subtus pallidis, nervis primariis utrinque circiter 5, curvato-adscendentibus, tenuibus, anastomosantibus, reticulis laxis; floribus 3 axillaribus, fasciculatis, pedicellis usque ad 1 cm longis, perianthi segmentis 5, ellipticis, obtusis, 2 ad 2.5 mm longis, exterioribus angustioribus; staminibus 5, filamentis liberis, 1 ad 1.2 mm longis, antheris ovatis, introrsis, longitudinaliter dehiscentibus, disco circiter 1 mm diametro.

A shrub or small tree, diœcious, entirely glabrous, the branches terete, pale brownish, 3 to 5 mm in diameter, the branchlets slender, terete, 1 to 1.5 mm in diameter, pale, up to 35 cm long. Leaves scattered, lanceolate, chartaceous to submembranaceous, 7 to 17 cm long, 1 to 2.5 cm wide, base acute, apex slenderly caudate-acuminate, upper surface olivaceous to dark brown when dry, lower surface pale; lateral nerves about 5 on each

side of the midrib, curved-ascending, slender, arched-anastomosing, the reticulations lax; petioles about 2 mm long; stipules caducous. Staminate flowers axillary, fascicled, pale yellow, 5-merous, their pedicels up to 1 cm long. Perianth segments elliptic-oblong, rounded, 2 to 2.5 mm long, the outer two narrower than the inner three. Stamens 5, their filaments free, 1 to 1.2 mm long, the anthers ovate, introrse, longitudinally dehiscent, the disk about 1 mm in diameter.

SAMAR, Loquilocon, *Bur. Sci.* 43867 McGregor, June, 1924.

Another species remote from any hitherto described Philippine forms, its vegetative characters suggestive of a narrow-leaved form of *Securinea flexuosa* Muell.-Arg.; the presence of a disk, however, indicates *Phyllanthus*. The lanceolate, caudate-acuminate, few-nerved, relatively large leaves are characteristic.

Genus SAPIUM P. Browne

Sapium discolor (Champ.) Muell.-Arg.

Sapium discolor (Champ.) MUELL.-ARG. in *Linnaea* 32 (1863) 121; PAX in *Pflanzenreich* 52 (1912) 239.

Stillingia discolor Champ. ex BENTH. in Hook. Kew Journ. Bot. 6 (1854) 1.

Excoecaria discolor MUELL.-ARG. in DC. Prodr. 15² (1866) 1210.

TAWITAWI, Sulu Archipelago, *Bur. Sci.* 44473 Ramos and Edaño, August, 1924, in forests along streams at low altitudes. Southeastern China to Hainan, Indo-China, and the Malay Peninsula.

This is rather an unexpected addition to our list of Philippine species, the specimens representing the typical Chinese form.

Genus CLEIDION Blume

Cleidion microcarpum sp. nov.

Frutex erectus, glaber, ramis ramulisque tenuibus, ramulis viridibus, ramis pallidis; foliis chartaceis, oblongis ad oblongo-ellipticis, in siccitate pallide viridibus, nitidis, 6 ad 11 cm longis, 2.5 ad 4 cm latis, utrinque subaequaliter angustatis, apice distincte sed obtuse acuminatis apiculatisque, basi obtusis vel subacutis, margine leviter undulatis, inter undulis glanduloso-denticulatis, nervis primariis utrinque 6 vel 7, tenuibus, distinctis, petiolo tenui, 1 ad 2 cm longo; inflorescentiis ♂ axillaribus, spicatis, multifloris, 3 ad 7 cm longis, ♀ paucifloris, floribus longe pedicellatis, fructibus leviter pubescentibus, plerumque 3-coccis, circiter 7 mm diametro.

A dioecious glabrous shrub 1 m high or more, the branches and branchlets slender, terete, the former pale, the latter greenish when dry, the very young parts sometimes slightly pubescent. Leaves chartaceous, pale greenish when dry, shining, oblong to oblong-elliptic, 6 to 11 cm long, 2.5 to 4 cm wide, subequally narrowed to the acute or obtuse base and to the acuminate apex, the acumen blunt and apiculate, the margins subundulate and glandular-denticulate between the undulations, lateral nerves 6 or 7 on each side of the midrib, slender, distinct, curved, arched-anastomosing, the reticulations lax; petioles slender, 1 to 2 cm long. Inflorescences axillary, solitary, the staminate ones spicate, slender, many-flowered, 3 to 7 cm long, the flowers fascicled at the nodes, sessile or subsessile, the bracteoles minute, scarcely 0.5 mm long. Sepals 3, broadly ovate subacute, 2 mm long. Stamens about 50, their filaments less than 1 mm long. Pistillate racemes 6 to 13 cm long, slender, each bearing a very few, long-pedicelled flowers, the pedicels 1.5 to 3 cm long, thickened in the upper part. Sepals 3, triangular-ovate, acute, 1 mm long. Ovary more or less appressed pubescent; style arms slender, 5 mm long. Capsule subglobose, normally of three cocci, when young slightly appressed-pubescent, ultimately glabrous, about 7 mm in diameter. Seeds subglobose, smooth, 5 mm in diameter.

TAWITAWI, Sulu Archipelago, *Bur. Sci.* 44226 Ramos and Edaña, August, 1924, near the border of mangrove swamps.

A species manifestly belonging in the group with *Cleidion lanceolatum* Merr. of Samar and Bohol, but with differently shaped, much broader leaves. In vegetative characters it approaches small-leaved forms of the common and widely distributed *Cleidion spiciflorum* (Burm. f.) Merr. (*C. javanicum* Blume), but in floral and fruit characters it closely approximates *Cleidion lanceolatum* Merr.

Genus CROTON Linnæus

Croton zambalense sp. nov.

Arbor circiter 6 m alta, ramis glabris, lenticellatis, partibus junioribus pallide stellato-pubescentibus; foliis submembranaceis, in siccitate utrinque viridibus, verruculosus, ad costa nervisque stellato-pubescentibus, subellipticis, 7 ad 12 cm longis, 3.5 ad 5.5 cm latis, obtusis, basi 2-glandulosis, late acutis ad rotundatis, 5-plinerviis, margine obscure irregulariter distanter crenato-serratis vel subundulatis, sinibus subtus cum glandulis

sessilibus intra-marginalibus ornatis, nervis utrinque 5 vel 6, adscendentibus, distinctis; inflorescentiis 9 ad 16 cm longis, leviter stellato-pubescentibus; floribus ♂ numerosis, plerumque 5-meris, 5 ad 6 mm diametro, sepalis extus leviter stellato-pubescentibus, petalis ad basin apiceque villosis, staminibus circiter 15. Floribus ♀ paucis, ovario dense subflavido-stellato-hirsuto; fructibus junioribus obovoideis, circiter 12 mm diametro.

A monoecious tree about 6 m high, the branches glabrous, dark-colored when dry, lenticellate, somewhat rugose, the branchlets rather densely stellate-pubescent with pale short stiff hairs. Leaves submembranaceous, green and of about the same color on both surfaces when dry, distinctly verruculose, subelliptic, 7 to 12 cm long, 3.5 to 5.5 cm wide, sparingly stellate-pubescent on the midrib and nerves on both surfaces, ultimately nearly glabrous, the apex obtuse, base broadly acute to rounded, 5-plinerved, and with a pair of sessile, conspicuous, pale, hard, shining glands on the lower surface, these with a central depression, margins distantly, obscurely, and irregularly crenate-serrate or subundulate, the sinuses on the lower surface with sessile glands similar to the basal pair but somewhat smaller; lateral nerves, including the basal ones, 5 or 6 on each side of the midrib, ascending, distinct; petioles 1 to 2.5 cm long, stellate-pubescent. Inflorescences terminal, rather slender, 9 to 16 cm long, more or less stellate-pubescent with pale stiff hairs. Staminate flowers numerous in the upper part, serially falling from the basal part upward, 5 to 6 mm in diameter, their pedicels about 3 mm long, mostly 5-merous. Sepals ovate to oblong-ovate, obtuse, thin, sparingly stellate-pubescent, 2.5 to 3 mm long. Petals oblong, 3 mm long, base and apex densely villous. Stamens about 15, their filaments glabrous, 2 mm long. Pistillate flowers few, near the base of the inflorescence, their sepals lanceolate, somewhat acuminate, 3 mm long, the pedicels stout, very densely stellate-hirsute with pale yellowish hairs. Ovary very densely stellate-hirsute; style bases about 2 mm long, more or less stellate-pubescent, the arms glabrous. Young fruits obovoid, about 12 mm in diameter, densely stellate-hirsute with pale yellowish hairs.

LUZON, Zambales Province, Mount Tapulao, *Bur. Sci.* 44709 *Ramos and Edaño*, November, 1924, on forested slopes, altitude about 900 meters.

Probably as closely allied to *Croton colubrinoides* Merr. as any other species, differing in its verruculose leaves, its indumentum, its sessile basal glands, and in other characters.

ANACARDIACEÆ

Genus *SEMECARPUS* Linnæus f.

Semecarpus stenophylla sp. nov.

Frutex vel arbor parva, inflorescentiis leviter pubescentibus exceptis glaber, ramis teretibus, ramulis circiter 2 mm diametro; foliis numerosis, confertis, anguste lanceolatis ad lineari-lanceolatis, rectis vel leviter falcatis, coriaceis, rigidis, usque ad 20 cm longis et 12 mm latis, utrinque subaequaliter angustatis, supra olivaceis, subtus pallidis; nervis lateralibus numerosis (usque ad 40 utrinque), patulis, arcuato-anastomosantibus, secundariis inter primariis transversis, ab illis angulo recto abuentes; paniculis circiter 10 cm longis, partibus junioribus plus minusve pubescentibus, sepalis triangulari-ovatis, acutis, 1 mm longis; drupa oblique ovata, glabra, subcastanea, 9 mm longa, hypocarpio carnoso, rubro.

A shrub or small tree, glabrous except the slightly pubescent inflorescences. Leaves numerous, crowded, narrowly lanceolate to linear-lanceolate, straight or slightly falcate, rigid, coriaceous, gradually and subequally narrowed at both ends, long acuminate, the tips obtuse, margins sometimes obscurely undulate, 12 to 20 cm long, 6 to 12 mm wide, upper surface olivaceous, lower pale, somewhat glaucous; lateral nerves numerous, straight, distinct, spreading, arched-anastomosing, up to 40 or more on each side of the midrib, the secondary nerves leaving the primary ones at right angles; petioles stout, 5 to 15 mm long. Panicles terminal, apparently few-flowered, about 10 cm long, the younger parts somewhat pubescent, the branches few, 2 to 3.5 cm long. Sepals triangular-ovate, acute, about 1 mm long. Mature fruits dark brown, obliquely ovoid, about 9 mm long, glabrous, the younger ones sparingly pubescent, the fleshy pedicels red when fresh, apparently larger than the drupes, when dry as long as the latter but narrower.

SAMAR, Loquilocon, *Bur. Sci.* 43866 *McGregor*, July, 1924.

A species very strongly characterized by its numerous, elongated, very narrow leaves, in this character differing radically from all hitherto described species of the genus. No notes, other than brief ones appertaining to the fruits, accom-

pany the specimens, but the material available rather clearly indicates that this stenophyllous *Semecarpus*, like many of the other stenophyllous Malaysian plants, grows along the margins of small streams in places subject to sudden and brief overflows.

ICACINACEÆ

Genus *IODES* Blume

Iodes ovalis Blume.

Iodes ovalis BLUME, Bijdr. (1825) 30; KING in Journ. As. Soc. Bengal 64² (1895) 128; RIDL., Fl. Mal. Penin. 1 (1922) 435.

JOLO, Sulu Archipelago, *Bur. Sci.* 44435 *Ramos and Edaño*. Along small streams in forests at low altitudes; rare.

The specimen has mature and immature fruits which are ovoid and somewhat compressed, very different from the oblong ones of *Iodes philippinensis* Merr., and the leaves are much larger. Whether or not this is the form that Blume actually described may be subject to some doubt, but in any case the specimens appear to be referable to the form described under this name by King and by Ridley; they, however, reduce *Iodes tomentella* Miq. to *Iodes ovalis* Blume, whereas the Dutch botanists, Koorders and others, retain the latter two as distinct. The Jolo form seems clearly to represent *Iodes ovalis* Blume as figured and described by Bennett in *Plantae Javanicae Rariores* (1852) 243, t. 48.

RHAMNACEÆ

Genus *ZIZYPHUS* Tournefort

Zizyphus suluensis sp. nov.

Frutex scandens, ramis glabris, teretibus, lenticellatis, spinis solitariis recurvatis armatis, ramulis tenuibus, pubescentibus; foliis subcoriaceis, oblongis ad oblongo-ellipticis, 4 ad 7 cm longis, perspicue sed obtuse acuminatis, basi leviter inaequaliteralibus, obtusis ad rotundatis, 3-nerviis, nervis secundariis lateralibus carentibus, margine minutissime glanduloso-denticulatis, junioribus ad nervis leviter pubescentibus, vetustioribus glabris; cymis axillaribus, parvis, paucifloris, breviter pedunculatis, 1 ad 1.5 cm longis, circiter 1.2 cm diametro, pubescentibus; floribus viridibus, circiter 5 mm diametro, extus pubescentibus, intus glabris, petalis cucullatis obovatis, inflexis, 1.5 mm longis.

A scandent shrub, the branchlets, petioles, inflorescences, and the younger leaves more or less pubescent with short, dark brown hairs. Branches terete, dark brown, lenticellate, glabrous, the branchlets slender, about 1 mm in diameter, the stipular spines

solitary, rather stout, recurved, 1.5 to 3 mm long. Leaves subcoriaceous, rather pale when dry, the older ones entirely glabrous, the younger ones sparingly pubescent along the nerves on both surfaces, oblong to oblong-elliptic, 4 to 7 cm long, 1.5 to 2.6 cm wide, base slightly inequilateral, obtuse to rounded, apex conspicuously blunt-acuminate, margins minutely glandular-denticulate; longitudinal nerves 3, impressed above, prominent beneath, the lateral pair extending into the acumen, lateral ones from the side nerves wanting, the reticulations fine, close; petioles slender, 3 to 5 mm long. Cymes axillary, small, few-flowered, more or less pubescent, 1 to 1.5 cm in diameter, their peduncles 1 cm long or less, the pedicels 2 to 3 mm long, the bracteoles oblong, obtuse, 1.5 mm long. Flowers greenish, about 5 mm in diameter, pubescent externally, glabrous within, the calyx lobes broadly triangular-ovate, acute or acuminate, 2 mm long. Petals obovate, cucullate, inflexed, 1.5 mm long. Filaments glabrous, 1.2 mm long. Disk 3 mm in diameter.

TAWITAWI, Sulu Archipelago, *Bur. Sci.* 44295 Ramos and Edaño, August, 1924, in damp forests along small streams at low altitudes.

A species well characterized by the entire absence of lateral nerves between the longitudinal pair and the leaf margins, except for the fine and rather close reticulations. Its alliance is manifestly with *Zizyphus elegans* Wall., for which the name *Z. subquinquenervia* Miq. should probably be accepted; the latter species, however, has prominent nerves between the longitudinal pair and the leaf margins. It is to be noted that King⁴ describes the cymes of *Zizyphus elegans* Wall. as having stalks as long as the leaves; doubtless "petioles" was intended, as Ridley describes the cymes as 0.6 inch long, which conforms with Miquel's description of *Zizyphus subquinquenervia* Miq., which King states is a synonym of Wallich's species. Except in leaf size the characters of *Zizyphus ornata* Miq., ex descr., apply closely to the present species.

STERCULIACEÆ

Genus STERCULIA Linnæus

Sterculia longisepala sp. nov.

Frutex circiter 2 m altus, ramulis et petiolis et inflorescentiis perspicue patule ciliato-hirsutis, ramulis 4 ad 5 mm diametro; foliis late oblongo-oblancheolatis, chartaceis, 15 ad 30 cm longis,

⁴Journ. As. Soc. Bengal 65² (1896) 374.

6 ad 11 cm latis, integris, perspicue tenuiter acuminatis, basi obtusis ad rotundato-cordatis, subtus plus minusve ciliato-hirsutis, nervis primariis utrinque circiter 12, perspicuis; petiolo 2 ad 7 cm longo; stipulis setaceis, ciliato-hirsutis, 1.5 ad 2 cm longis; paniculis terminalibus, angustis, plus minusve flexuosis, 15 ad 45 cm longis, 5 ad 7 cm latis, multifloris; floribus circiter 3 cm longis, calycis segmentis lineari-lanceolatis, 2.5 cm longis, deorsum circiter 3 mm latis, arcuatis, juvenilis leviter cohaerentibus, cito liberis.

A shrub about 2 m high, conspicuously ciliate-hirsute with rather stiff spreading, more or less ferruginous hairs. Branchlets 4 to 5 mm in diameter, the older parts glabrous, the younger parts conspicuously ciliate-hirsute as are the petioles, the long spreading hairs being intermixed with a short, denser indumentum. Leaves somewhat crowded near the tips of the branchlets, chartaceous, broadly oblanceolate, entire, 15 to 30 cm long, 6 to 11 cm wide, apex conspicuously acuminate, narrowed below, the base obtuse to rounded-cordate, the upper surface glabrous except for the ferruginous-pubescent and ciliate-hirsute midrib, the lower surface somewhat paler, ciliate-hirsute on the midrib, nerves and larger reticulations, and with shorter scattered stellate hairs on the reticulations; petioles 2 to 7 cm long; stipules setaceous, ciliate-hirsute, numerous, crowded near the apices of the branchlets, dark brown, 1.5 to 2 cm long. Panicles narrow, somewhat flexuous, 15 to 45 cm long, 5 to 7 cm wide, many-flowered, all parts conspicuously ferruginous ciliate-hirsute with spreading hairs which are intermixed with a shorter denser indumentum. Flowers reddish or brownish red, about 3 cm long, ciliate-hirsute, the tubular part about 6 mm long, slightly enlarged upward, base cuneate, the lobes 5, linear-lanceolate, arched, slightly cohering when young, soon free, about 2.5 cm long, 3 mm wide below, their margins revolute, gradually narrowed upward to the somewhat acuminate tip. Staminal column about 2 mm long, the anther mass depressed-globose, about 1.2 mm in diameter, the stamens 10, about 0.5 mm long. Pistillate flowers similar to the staminate ones, the ovary ovoid-globose, densely pubescent, 2 mm in diameter; style ciliate, 1.5 mm long, sharply bent to one side.

TAWITAWI, Sulu Archipelago, *Bur. Sci.* 44070 (type), 44157 *Ramos and Edaño*, July, 1924, in damp forests near small streams at low altitudes.

A species strongly characterized by its narrow setaceous stipules and its conspicuously ciliate-hirsute branchlets, stipules, petioles, and inflorescences, as well as by its elongated, narrow, more or less flexuous inflorescences, and its linear-lanceolate, elongated perianth lobes which when young are slightly coherent by their tips but soon free.

DIPTEROCARPACEÆ

Genus *VATICA* Linnæus

Vatica papuana Dyer.

Vatica papuana DYER in Journ. Bot. 16 (1878) 100; BRANDIS in Journ. Linn. Soc. Bot. 31 (1895) 127.

Vatica moluccana BURCK in Ann. Jard. Bot. Buitenz. 6 (1887) 226, t. 26.

Vatica schumanniana GILG in Engl. Bot. Jahrb. 18 (1894) Beibl. 45: 38.

TAWITAWI, Sulu Archipelago, *Bur. Sci.* 44349 *Ramos and Edaño*, August, 1924, in forests at low altitudes.

This species has not hitherto been recorded from the Philippines; in fact, no representative of the section *Retinodendron* has before been found within the limits of the Archipelago, although other representatives of the section occur from Ceylon to New Guinea. The specimen is a very close match for *Ramos 1903* from Batu Lima, near Sandakan, British North Borneo, originally referred by me to *Vatica rassak* Blume, but which Dr. Van Slooten finds to be referable to Dyer's species. Borneo, Moluccas, and New Guinea.

FLACOURTIACEÆ

Genus *FLACOURTIA* L'Héritier

Flacourtia rukam Zoll. and Mor. var. *myriantha* var. nov.

A typo differt floribus ♂ numerosissimis, ad nodos densissime confertis, inflorescentiis 1.5 ad 2.5 cm diametro.

JOLO, Sulu Archipelago, *Bur. Sci.* 43910 *Ramos and Edaño*, September, 1924, along small streams in forests near the summit of Mount Daho, altitude about 700 meters.

In general the specimens come well within the range of variation of the widely distributed *Flacourtia rukam* Zoll. and Mor., differing in the very numerous crowded staminate flowers. In the lower inflorescences, especially those in the axils of fallen

leaves, there are several hundred flowers in each, while in the uppermost inflorescences there may be as few as twenty-five flowers.

Genus **CASEARIA** Jacquin

Casearia nitens sp. nov.

Frutex circiter 3 m altus, juvenilis exceptis glaber, ramulis elongatis plus minusve flexuosis, laevis, brunneis, glabris; foliis integerrimis, chartaceis, oblongis, perspicue acuminatis, basi subaequilateralibus, rotundatis, in siccitate brunneis vel olivaceo-brunneis, subtus pallidioribus, utrinque nitidis, glaberrimis, 14 ad 20 cm longis, 5 ad 8 cm latis, nervis primariis utrinque 9 vel 10, perspicuis, reticulis tenuibus, distinctis, subparallelis, petiolis glabris, 12 ad 17 mm longis; floribus axillaribus, fasciculatis, paucis, glabris, circiter 3 mm longis; staminibus 10, staminoideis anguste oblongis, ciliatis; capsulis subellipsoideis, circiter 1 cm longis, apiculatis, laevis, haud carinatis vel sulcatis, seminibus paucis (circiter 4), ovoideis, arillus flavidus, leviter fimbriatus.

An almost entirely glabrous shrub about 3 m high, the tips of the young branchlets slightly pubescent. Ultimate branchlets greatly elongated, up to at least 60 cm long, somewhat zigzag-flexuous, smooth, brown, glabrous, the internodes 3 to 6 cm long. Leaves chartaceous, oblong, entirely glabrous, brown and shining on both surfaces when dry, paler beneath, 14 to 20 cm long, 5 to 8 cm wide, entire, the apex rather conspicuously acuminate, base subequilateral, rounded; lateral nerves 9 or 10 on each side of the midrib, prominent, curved, arched-anastomosing, the primary reticulations slender, distinct, rather close, subparallel; petioles glabrous, 12 to 17 mm long. Flowers yellow, in few-flowered, axillary fascicles, their pedicels glabrous, about 3 mm long. Sepals oblong-elliptic, rounded, entirely glabrous, 3 mm long. Stamens 10, the alternating ones slightly shorter than the others, the filaments slender, glabrous, 1.2 mm long, the alternating staminodes 10, narrowly oblong, ciliate, about as long as the stamens. Ovary narrowly ovoid, glabrous, the style about 1 mm long. Fruit yellow when fresh, castaneous when dry, shining, smooth, subellipsoid, apiculate, about 1 cm long, the pericarp not at all ridged or sulcate. Seeds few (about 4), ovoid, 4 mm long, the somewhat fleshy aril yellow, sparingly laciniate.

TAWITAWI, Sulu Archipelago, *Bur. Sci.* 44116 (type), 44128 Ramos and Edaño, August, 1924, in damp forested ravines at low altitudes.

The alliance of this species is apparently with *Casearia hosei* Merr. of Borneo, separated by its distinctly flexuous elongated branchlets and by being glabrous in all parts except the very youngest parts of the branchlets.

VIOLACEÆ

Genus RINOREA Aublet

Rinorea castilloi Merr.

Rinorea castilloi MERR. in Philip. Journ. Sci, 21 (1922) 530.

JOLO and TAWITAWI, Sulu Archipelago, *Bur. Sci.* 44017, 44163, 44447 Ramos and Edaño, in forests along small streams at low altitudes. British North Borneo and Banguay Island.

The specimens, all in fruit, match a fruiting specimen from Banguay Island, and the type, a flowering specimen from British North Borneo. Its true alliance seems to be with *Rinorea hirtella* (Ridl.) comb. nov. (*Alsodeia hirtella* Ridl.), of the Malay Peninsula, from which it is distinguished by its entirely glabrous leaves.

BEGONIACEÆ

Genus BEGONIA Linnæus

Begonia samarensis sp. nov. § *Petermannia*.

Suffruticosa, erecta, ramosa, circiter 2 m alta, ramis scabris, partibus junioribus adpresse ferrugineo-hirsutis; foliis subchartaceis, inaequilateraliter oblongis, 7 ad 11 cm longis, 2.5 ad 4 cm latis, basi lateraliter cordatis, margine denticulatis, sursum irregulariter dentato-lobatis, apice acuminatis, supra olivaceis, parce setulosis, subtus pallidioribus et ad costa nervisque ferrugineo-hirsutis; petiolo circiter 2 cm longo; inflorescentiis axillaribus, depauperato-cymosis, circiter 3 cm longis, parce ferrugineo-hirsutis; floribus ♂ paucis, sepalis 2, orbiculariovatis, rotundatis, circiter 8 mm diametro, extus parce setulosis; antheris circiter 25; capsulis 1 ad 1.5 cm longis, parce setulosis, aequaliter 3-alatis, apice truncatis, basi rotundatis.

An erect, suffrutescent, branched plant about 2 m high, the branches terete, hard, woody, about 4 mm in diameter, somewhat scabrous from the bases of the persistent hairs, the younger

parts more or less appressed ferruginous-hirsute. Leaves oblique, inequilateral, oblong, subchartaceous, 7 to 11 cm long, 2.5 to 4 cm wide, base laterally cordate, broader side rounded, narrower side subacute, apex acuminate, margins denticulate, and in the upper one-half or one-third irregularly dentate-lobed, the lobes few, acute, not exceeding 1 cm in length, the upper surface olivaceous, sparingly ferruginous-setulose, the lower surface paler and rather densely ferruginous-hirsute on the midrib and nerves, with scattered short stout hairs on the surface; petioles about 2 cm long; stipules lanceolate, deciduous, up to 1 cm long. Inflorescences axillary, depauperate-cymose, about 3 cm long, the branches few, slender, elongated, somewhat ferruginous-hirsute, and with rather numerous pairs of lanceolate, acuminate bracteoles 1.5 to 2 mm long. Staminate flowers few, the sepals 2, white, orbicular-ovate, about 8 mm in diameter, slightly setulose outside. Stamens about 25. Capsules solitary at the base of the staminate inflorescence, 1 to 1.5 cm long, and 1 cm wide, equally 3-winged, truncate at the apex, base rounded, sparingly setulose.

SAMAR, Loquilocon, *Bur. Sci.* 43757 McGregor, July, 1924, in hillside forests, altitude about 250 meters.

This was first referred to *Begonia jagori* Warb., which is very different in habit, with much shorter petioles and scarcely cordate leaves.

COMBRETACEÆ

Genus *TERMINALIA* Linnæus

Terminalia plagata sp. nov.

Arbor circiter 6 m alta, ramis glabris, circiter 7 mm crassis, ramulis cicatricibus multis instructis, 5 mm diametro, partibus junioribus adpresse ferrugineo-pubescentibus; foliis numerosis, in ramulis ultimis confertis, coriaceis ad subcoriaceis, oblongo-obovatis, supra minute punctatis, apice rotundatis, basi cuneatis, eglandulosis vel obscure biglandulosis, 6 ad 11 cm longis, 2.5 ad 6 cm latis, supra glabris, nitidis, subtus pallidioribus, leviter pubescentibus glabrescentibus, axillis domatiis perspicuis instructis, nervis utrinque circiter 10; spicis pubescentibus, circiter 10 cm longis; fructibus subellipsoideis, 2 ad 2.5 cm longis, circiter 1.5 cm crassis, glabris, laevis, rostrato-apiculatus, obscure compressis, haud carinatis, pericarpio circiter 5 mm crasso.

A tree about 6 m high, the branches glabrous, about 7 mm thick, reddish brown and grayish, the branchlets about 5 mm thick, marked with numerous scars of fallen leaves, the younger

parts appressed-pubescent with short ferruginous hairs. Leaves crowded near the tips of the branchlets, numerous, subcoriaceous, oblong-obovate, apex rounded, narrowed below to the cuneate base, 6 to 11 cm long, 2.5 to 6 cm wide, the younger ones more or less pubescent, the mature ones glabrous and shining on the upper surface, minutely puncticulate, greenish olivaceous, the lower surface paler, slightly pubescent, the base with or without a pair of glands, these when present obscure, the axils of the primary nerves with very conspicuous pits (domatia) sometimes nearly 1 mm in diameter; lateral nerves about 10 on each side of the midrib, slender, distinct, the reticulations fine; petioles ferruginous-pubescent, 6 to 11 mm long. Spikes about 10 cm long, more or less pubescent. Fruit red when mature, subellipsoid, 2 to 2.5 cm long, about 1.5 cm thick, obscurely compressed, not at all keeled, glabrous, smooth, shining, the apex somewhat rostrate-apiculate, the pericarp about 5 mm thick.

BILATAN ISLAND, immediately south of Tawitawi, Sulu Archipelago, *Bur. Sci.* 44338 Ramos and Edaña, July 31, 1924, in forests near the seashore.

Allied to *Terminalia pellucida* Presl, but with much smaller fruits. The large and conspicuous domatia are characteristic. It differs from *Terminalia edulis* Blanco in its differently shaped leaves and larger, scarcely compressed fruits.

MYRTACEÆ

Genus XANTHOMYRTUS Diels

Xanthomyrtus diplycosifolia (C. B. Rob.) comb. nov.

Eugenia diplycosifolia C. B. ROB. in Philip. Journ. Sci. 4 (1909) Bot. 347; MERR., Enum. Philip. Fl. Pl. 3 (1923) 165.

In addition to the specimens cited by me, we now have:

LUZON, Benguet Subprovince, Mount Pulog, *Bur. Sci.* 44976 Ramos and Edaña, February, 1925.

Xanthomyrtus aurea (Elm.) comb. nov.

Eugenia aurea ELM., Leaf. Philip. Bot. 4 (1912) 1400; MERR., Enum. Philip. Fl. Pl. 3 (1923) 158.

In addition to the specimens cited by me, we now have: MINDANAO, Davao Province, Mount Apo, Mrs. Clemens.

Diels⁶ has with good reasons segregated from *Myrtus* certain Malaysian and Papuan species, including one from New Caledonia, and probably one from northeastern Australia, some

⁶ Engl. Bot. Jahrb. 57 (1922) 362-367.

originally placed in *Myrtus*, others in *Eugenia*. The two Philippine species enumerated above, originally placed in *Eugenia*, appertain to *Xanthomyrtus*. In addition to the species placed here by Diels two Bornean species belong in *Xanthomyrtus*; namely, *Myrtus moultonii* Merr. and *Myrtus taxifolia* Ridl. *Xanthomyrtus* as at present constituted is represented by two species in the Philippines, three in Borneo, thirteen in New Guinea, one in New Caledonia, and apparently one in north-eastern Australia (*Myrtus metrosideros* Bailey).

Genus *EUGENIA* Micheli

Eugenia suluensis sp. nov. § *Jambosa*.

Arbor parva, glaberrima, ramis ramulisque rubro-brunneis, laevis, ramulis 2.5 ad 3 mm diametro, distincte 4-angulatis, junioribus interdum anguste 4-alatis; foliis oppositis, oblongis ad oblongo-ellipticis, coriaceis, olivaceis vel olivaceo-brunneis, nitidis, 15 ad 25 cm longis, 6 ad 9 cm latis, utrinque subaequaliter angustatis, apice acuminatis, basi acutis, vix punctatis; nervis primariis utrinque circiter 15, subtus valde perspicuis; inflorescentiis axillaribus terminalibusque, brevibus, paucifloris, calycis tubo circiter 1 cm longo, 8 mm diametro, lobis perspicue glandulosi.

A small glabrous tree, the branches and branchlets brownish red, smooth, the branchlets distinctly 4-angled and the younger ones often narrowly 4-winged, 2.5 to 3 mm in diameter. Leaves opposite, oblong to oblong-elliptic, coriaceous, the upper surface olivaceous and shining when dry, the lower surface brownish, not glandular-punctate, 15 to 25 cm long, 6 to 9 cm wide, the apex rather conspicuously acuminate, base acute; lateral nerves about 15 on each side of the midrib, very prominent on the lower surface, spreading, slightly curved, anastomosing directly with the equally distinct and scarcely arched marginal nerves 5 to 8 mm from the margin of the leaf, the alternating secondary nerves slightly more prominent than the rather lax reticulations; petioles stout, 5 to 7 mm long. Inflorescences axillary and terminal, few-flowered, the peduncle and axis at most 2.5 cm long, sometimes greatly reduced, the flowers then almost fascicled, rarely solitary, the bracts obscure, a single pair. Flowers white, the buds obovoid, distinctly stalked, the stalk thickening more or less after anthesis, the calyx about 1 cm long, including the stalklike part, and at most 8 mm in diameter, the lobes suborbicular-rounded, about 6 mm in diameter, prominently pitted

with conspicuous scattered glands. Stamens numerous, up to 10 mm long.

JOLO, Sulu Archipelago, *Bur. Sci.* 43916 Ramos and Edaña, September, 1924, in forests along small streams near the summit of Mount Daho, altitude about 700 meters.

A species probably as closely allied to *Eugenia hutchinsonii* Merr. as any other described form, but with very different leaves, and much fewer lateral nerves.

Eugenia montalbanica nom. nov.

Eugenia diospyrifolia MERR. in Philip. Journ. Sci. 27 (1925) 39, non Wall.

A new name is needed for the species based on *Loher* 13307, 13328, and 14879 from Montalban, Rizal Province, Luzon. The specific name *diospyrifolia* is preoccupied, a fact overlooked by me in describing this Philippine form.

MELASTOMATACEÆ

Genus ANPLECTRUM A. Gray

Anplectrum suluense sp. nov.

Frutex scandens, ramis teretibus, glabris, ramulis perspicue stellato-pubescentibus; foliis chartaceis, in siccitate viridibus, fragilis, supra glabris, nitidis, subtus parce stellato-pubescentibus, oblongis, 9 ad 14 cm longis, 3 ad 5 cm latis, basi late rotundatis, plerumque distincte cordatis, 5-nerviis, apice tenuiter acuminatis; petiolo 5 mm longo, stellato-pubescente, sursum parce setoso; inflorescentiis terminalibus, usque ad 30 cm longis, stellato-pubescentibus, ramis divaricatis; floribus 4-meris, calycis cylindrico-urceolatis, truncatis, 6 ad 7 mm longis, parce stellato-pubescentibus, haud setosis; petalis oblongo-ovatis, 6 ad 7 mm longis; staminibus 8, dimorphis, minoribus imperfectis, majoribus antheris curvatis, circiter 8 mm longis, connectivo basi antice bilamellato, postice 1-lamellato.

A scandent shrub, the branches terete, glabrous, the branchlets slender, more or less ferruginous-stellate-pubescent, the indumentum distinctly deciduous. Leaves oblong, chartaceous, green when dry, the upper surface glabrous, shining, the lower surface with scattered stellate ferruginous hairs, the nerves densely ferruginous-pubescent, 9 to 14 cm long, 3 to 5 cm wide, base broadly rounded, 5-nerved, distinctly cordate, apex slenderly acuminate, the inner, stouter pair of nerves reaching nearly to the apex; petioles about 5 mm long, densely stellate-pubescent

with ferruginous hairs, setose along the upper side, especially near the base of the leaf. Panicles terminal, up to 30 cm long, the lower branches subtended by somewhat reduced leaves, all parts more or less stellate-pubescent, the indumentum pale to ferruginous. Flowers 4-merous, numerous. Calyx sparingly stellate-pubescent, cylindric-urceolate, truncate, 6 to 7 mm long, 3 to 3.5 mm in diameter. Petals white, oblong-ovate, acute to obtuse, glabrous, 6 to 7 mm long, about 3.5 mm wide. Stamens 8, dimorphous, the alternate, smaller ones infertile. Fertile stamens with filaments about 5 mm long, the anthers lanceolate, strongly curved, about 8 mm long, connectives not produced, supplied on the inner side with two membranaceous, ovate appendages about 0.5 mm long, and on the back with a single similar appendage 1 mm in length. Sterile anthers at most 4 mm in length, the anterior and dorsal appendages oblong, 1.5 mm long, similar in size and shape.

JOLO, Sulu Archipelago, *Bur. Sci.* 44461 Ramos and Edaña, along small streams in forests at low altitudes, rare.

The alliance of this species is manifestly with *Anplectrum divaricatum* (Willd.) Triana, of the Malay Peninsula, Sumatra, Java, and Borneo, but it has larger leaves, very different connective appendages, especially the dorsal one, and the calyces are not at all setose. The first representative of the genus to be found within the limits of the Philippine Archipelago, *Anplectrum divaricatum* (Willd.) Triana having been erroneously credited to the group by Fernandez-Villar.

UMBELLIFERÆ

Genus PEUCEDANUM Tournefort

Peucedanum japonicum Thunb.

Peucedanum japonicum THUNB., Fl. Jap. (1784) 117.

SABTAN, Batan Islands, *Merrill* 11755, May, 1923, in crevices of cliffs along the seashore.

The genus is new to the Philippine flora, the species, as currently interpreted, extending from Japan to Formosa. Thunberg's species is erroneously reduced in *Index Kewensis* to *Ligusticum acutifolium*, an error for *L. acutilobum* S. and Z. Dr. O. Juel, of Upsala, to whom a fragment of the Philippine plant was sent, states that it is very similar to Thunberg's type, the latter having pubescent pedicels and slightly pubescent fruits, whereas the Sabtan plant is glabrous. Dr. B. Hayata states that

the specimen cited above is identical with the Formosan form referred to *Peucedanum japonicum* Thunb., which he is inclined to consider as specifically distinct from the Japanese form, it having more rounded leaf lobes. I suspect that the record of *Ligusticum acutilobum* S. and Z. as Formosan was based on the erroneous reduction of Thunberg's species, and that the form so recorded from Formosa is really the present species.

ERICACEÆ

Genus RHODODENDRON Linnæus

Rhododendron taxifolium sp. nov.

Frutex epiphyticus circiter 1 m altus, ramis glabris, ramulis glabris vel obscurissime puberulis, parce lepidotis, teretibus, 1 ad 1.5 mm diametro, internodiis 1 ad 3 cm longis; foliis numerosissimis ad nodis pseudovorticillatim-confertis, coriaceis, rigidis, viridibus, linearis, 2 ad 3.5 cm longis, 1 ad 1.5 mm latis, obtusis, sessilibus vel subsessilibus, subtus parce lepidotis; floribus terminalibus, solitariis vel paucis, subcampanulatis, albidis, circiter 2 cm longis, extus parce lepidotis, lobis late obovatis, rotundatis, 1 cm longis.

An epiphytic shrub about 1 m high. Branches terete, glabrous, ultimate branchlets slender, 1 to 1.5 mm in diameter, glabrous or very obscurely puberulent, the younger ones sparingly lepidote; internodes 1 to 3 cm long. Leaves numerous, crowded in pseudovorticels at the nodes, often twenty or more in a pseudovortical, green, linear, sessile or subsessile, obtuse, 2 to 3.5 cm long, 1 to 1.5 mm wide, rigid, coriaceous, shining, beneath (at least when young) sparingly lepidote, ultimately glabrous, the margins very obscurely crenulate. Flowers subcampanulate, white, terminal, solitary or few, about 2 cm long, their pedicels pubescent, somewhat lepidote, about 1 cm long. Calyx 3 to 4 mm in diameter, lepidote and pubescent. Corolla tube about 1 cm long, 6 mm in diameter, sparingly lepidote outside, pubescent within, the lobes broadly obovate, rounded, 1 cm long. Stamens 10, subequal, the filaments 10 to 11 mm long, pubescent below, glabrous above; anthers oblong, obtuse, 2.5 mm long. Ovary oblong, pubescent, 3 mm long; style about 6 mm long, pubescent in the lower one-half, glabrous above.

LUZON, Benguet Subprovince, Mount Pulog, *Bur. Sci.* 44880 *Ramos and Edaño* (type), *Mrs. Clemens* 15763, February, 1925, on trees in the mossy forest, altitude about 2,700 meters.

A most remarkable species strongly characterized by its numerous, pseudoverticillate, *Taxus*-like leaves, whence its specific name.

MYRSINACEÆ

Genus DISCOCALYX Mez

Discocalyx suluensis sp. nov.

Frutex glaber, circiter 1 m altus, ramulis ultimis crassis, rugosis, 5 ad 8 mm diametro; foliis ad apices ramulorum plus minusve confertis, chartaceis vel subcoriaceis, integerrimis, oblanceolatis ad oblongo-oblanceolatis, sessilibus vel brevissime crasseque petiolatis, 30 ad 40 cm longis, 6 ad 9 cm latis, apice acutis, deorsum angustatis, basi acutis vel obtusis, utrinque glanduloso-puncticulatis, nitidis, olivaceo-viridibus, nervis primariis utrinque circiter 20, perspicuis, irregularis, arcuato-anastomosantibus, reticulis laxis; inflorescentiis lateralibus, in ramulis specialibus crassis claviformis, circiter 2 cm longis dispositis; paniculis angustis, 4 ad 5 cm longis; floribus 5-meris, calycis lobis rotundatis, brevibus, glanduloso-punctatis.

A glabrous shrub, about 1 m high, apparently unbranched, the ultimate branches (or upper part of the main stem) terete, rugose, 5 to 8 mm in diameter. Leaves more or less crowded, chartaceous to subcoriaceous, entire, oblanceolate to oblong-oblanceolate, 30 to 40 cm long, 6 to 9 cm wide, apex acute, narrowed below to the acute or slightly obtuse base, subsessile or with a very short stout petiole, both surfaces greenish olivaceous and shining when dry, glandular-punctate; lateral nerves about 20 on each side of the midrib, distant, irregular, arched-anastomosing, prominent, the reticulations lax; petioles very short or wanting, up to 5 mm wide. Panicles few, narrow, 4 to 5 cm long, borne at or near the tips of special leafless lateral branches, these branches spreading at right angles, club-shaped, about 2 cm long, 3 mm in diameter below and somewhat thickened upward, the upper part with scars of fallen bracts and peduncles. Young fruits 5 to 6 mm in diameter, crowned by the sessile stigma, the calyces thin, 2.5 to 3 mm in diameter, with five very short, broadly rounded lobes, conspicuously glandular-punctate with reddish or yellowish glands.

TAWITAWI, Sulu Archipelago, *Bur. Sci.* 44293 Ramos and Edaño, July, 1924, in damp forests at low altitudes.

A species characterized by its entire, elongated, oblanceolate leaves and its short, lateral, club-shaped special branches bearing the narrow inflorescences. The lateral branches of the panicles, in fruit, do not exceed 5 mm in length.

EBENACEÆ

Genus DIOSPYROS Linnæus

Diospyros elliptifolia sp. nov.

Arbor parva, glabra (floribus ignotis), ramulis ultimis tenuibus, in siccitate nigris, laevis, circiter 1.5 mm diametro; foliis coriaceis, ellipticis, in siccitate supra subolivaceis vel pallidis, subtus pallidioribus, laevis, 10 ad 20 cm longis, 6 ad 11 cm latis, apice breviter obtuseque acuminatis, basi, late acutis ad subrotundatis; nervis lateralibus supra subobsoletis, subtus tenuibus, distinctis, circiter 7 utrinque, distantibus, arcuato-anastomosantibus, reticulis laxis, subobsoletis, petiolis crassis, circiter 3 mm longis; fructibus axillaribus, solitariis, sessilibus, subglobosis, in siccitate laevis, nitidis, atris, circiter 2 cm diametro, calycis lobis accrescentibus, coriaceis, oblongo-ovatis, acutis, 1 ad 1.3 cm longis.

A small glabrous tree (flowers unknown), the branches and branchlets terete, the latter black when dry, smooth, slender, about 1.5 mm in diameter. Leaves coriaceous, in texture tough when dry, scarcely brittle, elliptic, 10 to 20 cm long, 6 to 11 cm wide, the apex rather abruptly, shortly, and broadly blunt-acuminate, base broadly acute to rounded, olivaceous or pale and shining on the upper surface when dry, the lower surface paler, dull; lateral nerves subobsolete on the upper surface, beneath slender, distinct, distant, arched-anastomosing, about 7 on each side of the midrib, the reticulations lax, subobsolete; petioles about 3 mm long. Fruits axillary, solitary, sessile, globose, about 2 cm in diameter, smooth, black, and shining when dry, the pericarp when dry thin, brittle. Calyx lobes accrescent, coriaceous, oblong-ovate, acute, 1 to 1.3 cm long, with somewhat radiating faint nerves, the central portion sometimes slightly longitudinally sulcate.

TAWITAWI, Sulu Archipelago, *Bur. Sci.* 44020 Ramos and Edaña, in damp forests along small streams at low altitudes; rare.

A species well characterized by its accrescent, ovate to oblong-ovate, glabrous, coriaceous, acute, nearly plane calyx lobes; its globose, black, shining fruits; and its elliptic, shortly petioled, distantly nerved, coriaceous leaves, the reticulations lax and subobsolete.

Diospyros suluensis sp. nov.

Arbor circiter 10 m alta, partibus junioribus plus minusve pubescentibus, ramulis elongatis, ultimis usque ad 60 cm longis, teretibus; foliis oblongo-lanceolatis, chartaceis, acute acuminatis, basi plerumque rotundatis, circiter 20 cm longis, 5 ad 7 cm latis, utrinque glabris vel subtus ad costa puberulis, supra olivaceis, laevis, nitidis, subtus brunneis, nervis primariis utrinque circiter 15, tenuibus, distinctis, arcuato-anastomosantibus, reticulis tenuibus, distinctis; inflorescentiis brevibus, racemosis, in ramis vetustioribus, racemis paucifloris, pubescentibus, ut videtur circiter 2 cm longis; fructibus ovoideo-ellipsoideis, laevis, glabris, 3.5 ad 4 cm longis, circiter 3 cm diametro, calycibus accrescentibus, lignosis, circiter 3.5 cm diametro, 5-lobatis, lobis triangulari-ovatis, acutis.

A tree about 10 m high, the younger parts more or less pubescent. Branches terete, glabrous, the branchlets elongated, up to 60 cm long, older parts glabrous, younger parts slightly pubescent, the upper portions 1.5 to 2 mm in diameter. Leaves chartaceous, oblong-lanceolate, slenderly and sharply acuminate, base mostly rounded, about 20 cm long, 5 to 7 cm wide, the upper surface smooth, olivaceous, entirely glabrous, the midrib impressed, the lower surface paler, brownish, sparingly puberulent on the midrib; lateral nerves slender, distinct, arched-anastomosing, about 15 on each side of the midrib, the reticulations fine, rather close, distinct; petioles glabrous or slightly pubescent, about 5 mm long. Inflorescences racemose, from the axils of fallen leaves on branches about 1 cm thick, the racemes pubescent, apparently about 2 cm long (judging from fruiting specimens), few-flowered, the persistent pedicels 5 to 8 mm long, stout, the axis of the raceme forming a stout, 2 cm long pedicel for the solitary fruit. Fruit said to be red when mature, when apparently full grown but immature ovoid-ellipsoid, 3.5 to 4 cm long, about 3 cm in diameter, smooth, glabrous, the pericarp about 2 mm thick, apex rounded. Accrescent calyx woody, about 3.5 cm in diameter, with numerous rounded or ellipsoid lenticels, 5-lobed, the lobes broadly triangular-ovate, acute, 1.2

to 2 cm wide, about 1.5 cm long, the sinuses subacute and somewhat thickened.

TAWITAWI, Sulu Archipelago, *Bur. Sci.* 44068 Ramos and Edaña, August, 1924, in forests along small streams at low altitudes.

Perhaps as closely allied to *Diospyros pauciflorus* C. B. Rob. as any other described form, but with very different fruits.

APOCYNACEÆ

Genus KIBATALIA G. Don

Kibatalia puberula sp. nov.

Arbor parva, ramulis foliisque subtus puberulis; foliis subcoriaceis, ellipticis, brevissime (ca. 2 mm) petiolatis, basi rotundatis, plerumque leviter inaequilateralibus, apice breviter abrupte obtuseque acuminatis, 12 ad 16 cm longis, 5 ad 9 cm latis, nervis primariis utrinque 8 ad 10; floribus terminalibus, solitariis, albidis, circiter 7 cm longis, pedicellis 2.5 ad 3 cm longis, sepalis extus puberulis, late ovatis, obtusis, 3 ad 4 mm longis, corollae tubo 1.5 cm longo, lobis oblongo-oblancheolatis ad oblancheolatis, falcatis, obtusis, usque ad 6.5 cm longis, 8 ad 12 mm latis.

A small tree, the branchlets, pedicels, and lower surface of the leaves distinctly puberulent, the branches 3 to 4 mm in diameter, terete, glabrous. Leaves subcoriaceous, rather pale when dry, scarcely or but slightly shining, elliptic, 12 to 16 cm long, 5 to 9 cm wide, base rounded, usually somewhat inequilateral, apex very shortly and abruptly obtuse-acuminate; lateral nerves 8 to 10 on each side of the midrib, distinct; petioles stout, about 2 mm long. Flowers white, solitary, terminal, about 7 cm long, their pedicels puberulent, somewhat thickened upward, 2.5 to 3 cm long. Sepals broadly ovate, obtuse, externally puberulent, 3 to 4 mm long, the basal internal glands compressed, white, ovate to subreniform, about 1 mm in diameter. Corolla tube glabrous, about 1.5 cm long, the lobes oblong-oblancheolate to oblancheolate, falcate, obtuse, up to 6.5 cm long, 8 to 12 mm wide, narrowed below. Disk glands suborbicular, rounded-truncate, their margins ciliate, 1 to 1.5 mm in diameter. Anthers lanceolate, acuminate, 6 mm long, the connectives appressed-hirsute in the upper part. Carpels glabrous; styles 6 to 7 mm long.

SAMAR, Loquilocon, *Bur. Sci.* 43767 McGregor, July, 1924, a small tree overhanging streams at 250 meters altitude.

A species well characterized by its indumentum as well as by its very shortly petioled leaves. For the reasons why *Kibatalia* G. Don should be maintained in place of *Kickxia* Blume, see Merrill.*

VERBENACEÆ

Genus CLERODENDRON Linnæus

Clerodendron flavum sp. nov.

Frutex circiter 1 m altus, ramulis inflorescentiisque dense sordide pubescentibus; foliis membranaceis, subellipticis, integris, supra glabris, laevis, olivaceis, subtus ad costa nervisque puberulis, glandulis paucis disciformibus instructis, usque ad 30 cm longis et 16 cm latis, apice late acutis, basi rotundatis, nervis primariis utrinque circiter 9, perspicuis; petiolo 2 ad 6 cm longo; paniculis terminalibus, erectis, circiter 15 cm longis, dense multifloris, bracteis bracteolisque parvis; calycis 8 mm longis, puberulis, lobis 5, lanceolatis, acuminatis, 6 mm longis, glandulis paucis disciformibus instructis; corollae flavae, tubo glabro vel leviter puberulo, tenue, 16 mm longae; lobis oblongo-ovatis, rotundatis, 1 cm longis, filamentis glabris, exsertis, rubris.

An erect shrub about 1 m high, the branches terete, grayish, glabrous, the ultimate branchlets densely pubescent with dirty brown hairs. Leaves somewhat crowded near the tips of the branchlets, membranaceous, olivaceous, subelliptic or broadly elliptic, entire, apex broadly acute, base rounded, 15 to 30 cm long, 10 to 16 cm wide, the upper surface olivaceous, smooth, glabrous, the lower slightly paler, distinctly puberulent on the midrib, nerves, and reticulations, and with widely scattered, small, disklike glands; petioles rather densely pubescent, 2 to 6 cm long. Panicles terminal, erect, densely many-flowered, about 15 cm long and wide, rather densely pubescent with dirty brown hairs, the primary branches up to 8 cm long, spreading or somewhat ascending, the lower ones subtended by greatly reduced leaves not exceeding 1.5 cm in length, these sometimes wanting; bracts and bracteoles small, deciduous, the latter scarcely 1 mm in length. Flowers yellow. Calyx about 8 mm long, sparingly pubescent or puberulent, the lobes 5, lanceolate, acuminate, slenderly 3-nerved, about 6 mm long, 1.5 mm wide, outside supplied with scattered, small, often rather obscure, disklike glands. Corolla tube slender, 1.6 cm long, glabrous or slightly puberulent,

* Philip. Journ. Sci. 17 (1920) 306-310.

the lobes spreading, subequal, oblong-obovate, broadly rounded, about 1 cm long and 5 mm wide. Stamens glabrous, exerted about 2 cm, red when fresh.

JOLO, Sulu Archipelago, *Bur. Sci.* 43899 Ramos and Edaño, September, 1924, in forests along small streams near the summit of Mount Daho, altitude about 700 meters.

A species remarkable for its yellow flowers, manifestly belonging in the group with *Clerodendron williamsii* Elm., but differing in very numerous characters. It is clearly more closely allied to *Clerodendron myrmecophyllum* Ridl. of the Malay Peninsula and Borneo than it is to *C. williamsii* Elm. I do not agree with Bakhuizen¹ in his reduction of the two species mentioned above as varieties of the Javan *Clerodendron macrophyllum* Blume.

Genus **CALLICARPA** Linnæus

Callicarpa nigrescens sp. nov.

Frutex circiter 2 m altus, ramis teretibus, glabris vel subglabris, ramulis tenuibus, dense minuteque stellato-subfurfuraceis vel stellato-sublepidotis, foliis membranaceis vel subchartaceis, oblongis ad late oblongo-lanceolatis, usque ad 15 cm longis et 6 cm latis, tenuiter acuminatis, basi acutis ad decurrento-acuminatis, marginis crenatis vel crenato-dentatis, vetustioribus supra glaberrimis, nitidis, nigricantibus, subtus paullo pallidioribus, minute denseque foveolatis, glandulosis, parce stellato-pubescentibus praesertim ad costa nervisque; nervis lateralibus circiter 7 utrinque, curvato-adscendentibus, tenuibus, distinctis; cymis axillaribus, petiolo subaequantibus, dense multifloris; floribus 4-meris, calycis truncatis, dense stellato-pubescentibus, corolla glabra vel subglabra.

A shrub about 2 m high, the branches terete, older ones glabrous, the branchlets slender, densely and minutely stellate-furfuraceous or stellate-sublepidote, the indumentum brown or pale. Leaves opposite, membranaceous to subchartaceous, oblong to broadly oblong-lanceolate, 6 to 15 cm long, 3 to 6 cm wide, slenderly and sharply almost caudate-acuminate, base acute or decurrent-acuminate, margins crenate or crenate-dentate, the upper surface dark brown to black and shining when dry, entirely glabrous or with scattered stellate hairs when immature, the lower surface paler than the upper, minutely and rather densely pitted and with numerous shining glands, the indumentum of

¹ Bull. Jard. Bot. Buitenz. III 5 (1922) 82.

short, pale, stellate, scattered hairs, for the most part confined to the midrib and lateral nerves; lateral nerves about 7 on each side of the midrib, slender, curved-ascending, distinct; petioles 1 to 3 cm long, minutely and rather densely stellate-pubescent. Cymes axillary, mostly densely flowered, about as long as the petioles, the peduncle, branches, and calyces densely and minutely stellate-pubescent with pale or brownish hairs, the pedicels about 1.5 mm long, the bracteoles linear, 0.5 mm long. Calyx truncate, about 2 mm long, 1.5 mm in diameter, narrowed below to the cuneate base. Corolla tube 2 mm long, glabrous, the lobes 4, oblong-elliptic, rounded, glabrous or very slightly pubescent above, about 1.5 mm long. Filaments glabrous, 4 to 4.5 mm long; anthers oblong, 1.3 mm long. Style exerted, glabrous, 7 mm long. Fruit globose, glabrous, black when dry, about 2 mm in diameter.

TAWITAWI, Sulu Archipelago, *Bur. Sci.* 44297 (type), 44198 *Ramos and Edaña*, July and August, 1924, in secondary forests at low altitudes.

A species rather well characterized within the genus by its very short indumentum, which is dense on the branchlets and inflorescences, and wanting or very sparse on the vegetative parts. The leaves are characteristically black or dark colored on the upper surface when dry, as in *Callicarpa cana* Linn. and *C. bicolor* Juss., and the species is apparently allied to these in spite of the differences in indumentum. According to Bakhui-zen's arrangement of the species, it would apparently fall near or with *Callicarpa japonica* Thunb. and *C. longifolia* Lam., to neither of which can it be properly referred. I doubt very much if any of the Philippine or Malaysian material is properly referable to Thunberg's species.

ACANTHACEÆ

Genus RUELLIA Plumier

Ruellia luzoniensis sp. nov.

Herba erecta, leviter ramosa, ramis plerumque viridibus, plus minusve cinereo-puberulis; foliis lanceolatis ad oblongo-lanceolatis, in siccitate fragilis, viridibus, utrinque cystolithis numerosis instructis, integris, acutis ad acuminatis, basi acutis, subchartaceis, 6 ad 13 cm longis, 2 ad 4 cm latis, petiolo 8 ad 18 mm longo; floribus axillaribus, solitariis, sessilibus, pallide caeruleis, circiter 7 cm longis, extus leviter pubescentibus, bracteis

oblanceolatis, foliaceis, 2 ad 3 cm longis; capsulis circiter 1.8 cm longis, pubescentibus.

An erect, sparingly branched herb 35 to 45 cm high, the stems 2 to 3 mm in diameter, usually dark-colored when dry, terete, the branches usually green or dark green, cinereous-puberulent, obscurely sulcate. Leaves of each pair equal, lanceolate to oblong-lanceolate, 6 to 13 cm long, 2 to 4 cm wide, green when dry, with numerous cystoliths on both surfaces, entire, acute or acuminate, base acute, the younger ones sparingly pubescent, older ones glabrous; lateral nerves 5 to 7 on each side of the midrib, slender; petioles 8 to 18 mm long. Flowers axillary, solitary, sessile, pale blue, about 7 cm long. Bracts oblanceolate, 2 to 3 cm long, 2.5 to 4 mm wide, foliaceous, sparingly pubescent, acuminate. Calyx more or less pubescent, the tube short, the lobes 5, equal, narrowly lanceolate, acuminate, 4 to 4.5 mm long. Corolla more or less pubescent externally with short, white, scattered hairs, the tube about 7 cm long, the lower 3 mm rather slender, cylindric, then amplified and 8 to 10 mm in diameter, the lobes broadly ovate, rounded, 1.5 to 2 cm long. Style filiform, at least 5 cm long, sparingly ciliate-hirsute throughout. Filaments glabrous, the anthers 2.5 mm long. Capsule about 1.8 cm long, cinereous-pubescent, about 7.5 mm in diameter in the thickened upper portion, thickly rostrate, narrowed below. Seeds few, glabrous.

LUZON, Zambales Province, Anuling, *Bur. Sci.* 44627 Ramos and Edaña, November, 1924, in forests along streams at low altitudes.

A species resembling luxuriant forms of *Ruellia repens* Linn., differing in its larger leaves and in its very much larger flowers, which attain a length of 7 cm.

Genus PSEUDERANTHEMUM Radlkofer

Pseuderanthemum confusum sp. nov.

Suffruticosa, erecta, vix ramosa, 25 ad 40 cm alta, glabra vel subglabra, caulis glabris, teretibus; 2 ad 3 mm diametro, partibus junioribus glabris vel leviter obscure pubescentibus; foliis membranaceis ad chartaceis, oblongo-ovatis ad elliptico-ovatis, glabris, supra plus minusve lineolatis, olivaceis, subtus pallidioribus, 6 ad 15 cm longis, 3.5 ad 6 cm latis utrinque subaequaliter angustatis, apice acuminatis, basi acutis ad decurrento-acuminatis, nervis primariis utrinque 7 ad 9, tenuibus, distinctis; petiolo 1 ad 2.5 cm longo; spicis terminalibus, erectis, multifloris,

6 ad 11 cm longis, glabris vel obscure pubescentibus; floribus albis, glabris, tubo 3 cm longo.

An erect, unbranched, nearly glabrous, suffrutescent plant 25 to 40 cm high, the stems terete, 2 to 3 mm in diameter, the younger parts sometimes obscurely pubescent. Leaves in equal pairs, membranaceous to chartaceous, oblong-ovate to elliptic-ovate, 6 to 15 cm long, 3.5 to 6 cm wide, subequally narrowed to the acuminate apex and to the acute or decurrent-acuminate base, the upper surface olivaceous, with more or less conspicuous, irregularly disposed cystoliths, the lower surface somewhat paler; lateral nerves slender, distinct, 7 to 9 on each side of the midrib; petioles 1 to 2.5 cm long. Spikes terminal, solitary, 6 to 11 cm long, glabrous or obscurely pubescent, the bracts lanceolate, 1 to 1.5 mm long, acuminate. Sepals lanceolate, about 1.5 mm long, glabrous or nearly so. Corolla white, the tube slender, glabrous, about 3 cm long, the lobes spreading, about 1 cm in length. Capsules glabrous, 2 cm long, the thickened seed-bearing portion about as long as the narrowed basal part. Seeds compressed, 4 mm in diameter.

TAWITAWI, Sulu Archipelago, *Bur. Sci.* 44296 *Ramos and Edaño* (type), August, 1924, in damp forests along small streams at low altitudes. The same species is also represented by *Castro and Melegrito 1611* from Banguay Island, a fruiting specimen, and by *Wood 445* from British North Borneo, previously reported by me as *Pseuderanthemum album* (Roxb.) Merr. Ridley^a is authority for the statement that *Eranthemum album* as interpreted by King and Gamble is apparently *Pseuderanthemum graciliflorum* Ridl., certainly not *Eranthemum album* Nees. The present species is apparently allied to *Pseuderanthemum kingii* Ridl. of the Malay Peninsula and *P. diversifolium* (Miq.) Koord. of Java.

RUBIACEÆ

Genus IXORA Linnæus

Ixora grandifolia (Blume) Zoll. & Mor.

Ixora grandifolia (Blume) ZOLL. and MOR., *Syst. Verzeich. Zoll. Pfl.* (1854-1855) 65; KOORD. and VAL., *Bijdr. Boomsoort Java* 3 (1902) 150; KOORD., *Atlas Baumart. Java* 3 (1915) f. 545.

Pavetta macrophylla BLUME, *Bijdr.* (1826) 953.

TAWITAWI, Sulu Archipelago, *Bur. Sci.* 44011 *Ramos and Edaño*, August, 1924, in forests at low altitudes.

^a Fl. Mal. Penin. 2 (1923) 592.

The specimens, although in fruit, apparently represent the typical form of this Malayan species, which is here credited to the Archipelago for the first time other than Fernandez-Villar's and Vidal's identifications of the very different *Ixora macrophylla* Bartl. with this species. Malay Peninsula, Sumatra, Java, and Borneo.

CUCURBITACEÆ

Genus ZANONIA Linnæus

Zanonia indica Linn.

Zanonia indica LINN., Sp. Pl. ed. 2 (1763) 1457; COGN. in DC. Monog. Phan. 3 (1881) 926; Pflanzenreich 69 (1916) 27.

Alsomitra simplicifolia MERR., in Philip. Journ. Sci. 20 (1922) 470; Enum. Philip. Pl. 3 (1923) 579.

Jussia borneensis MERR., in Journ. Straits Branch Roy. As. Soc. 85 (1922) 170.

MINDANAO, Zamboanga District, *Bur. Sci.* 37397 *Ramos and Edaño*. TAWITAWI, Sulu Archipelago, *Bur. Sci.* 43947 *Ramos and Edaño*. Along streams in forests. India and Ceylon through Malaysia to New Guinea and New Mecklenburg.

This is here recorded to verify the occurrence of this monotypic genus in the Philippines and to place the two synonyms listed. Fernandez-Villar's⁹ record of it as Philippine was undoubtedly based on a representative of some other genus erroneously identified. *Jussia borneensis* Merr., described from Bornean material, has been correctly reduced to *Zanonia indica* Linn. by Harms¹⁰ who has also¹¹ indicated that the type collection of *Alsomitra simplicifolia* Merr. is *Zanonia indica* Linn. with immature fruits.

COMPOSITÆ

Genus WEDELIA Jacquin

Wedelia stenophylla sp. nov.

Herba erecta vel scandens, ramis scaberulis, circiter 2 mm diametro, rigidis; foliis lineari-lanceolatis, distanter lobulatis, 2.5 ad 6 cm longis, usque ad 5 mm latis, asperis, subtus hirsutis; capitulis turbinatis, circiter 9 mm diametro, squamis oblongo-lanceolatis, obtusis ad acuminatis, 4 ad 5 mm longis, hispidis; acheniis immaturis, 2 mm longis, apice truncatis, pilosis,

⁹ Novis. App. (1880) 98.

¹⁰ Über die Gattung *Jussia* Merrill, Notizbl. Bot. Gart. Berlin 8 (1924) 717-719.

¹¹ Engl. Bot. Jahrb. 60 (1925) 154.

An erect or scandent herb, the branches rigid, terete, 2 mm in diameter, scaberulous. Leaves (in the upper part of the plant) linear-lanceolate, distantly and irregularly lobulate, the lobules oblong, obtuse, scarcely exceeding 2 mm in length, the upper surface hispid, asperous, the lower surface with pale hairs, 2.5 to 6 cm long, 2 to 5 mm wide. Heads mostly solitary, long peduncled, turbinate, about 9 mm in diameter, the outer involucral bracts pubescent, oblong-lanceolate, obtuse to acuminate, 4 to 5 mm long, hispid, the inner ones narrower and more acuminate, the disk paleæ lanceolate to oblanceolate, 4 to 5 mm long, slightly acuminate. Ray flowers few, 6 to 7 mm long; ligules oblong-elliptic, 4 mm long, 2 mm wide, yellow, entire or obscurely 2-toothed. Disk flowers perfect, 5 mm long. Achenes (immature) 2 mm long, their apices truncate, pilose, sometimes bearing a single straight bristle 0.5 to 1 mm long.

MINDANAO, Misamis Province, *For. Bur.* 29751 *Caster*, on the top of Angyar Ridge, altitude about 400 meters.

A species very strongly marked in its exceedingly narrow leaves. The collector indicates its height as about 1 meter, but does not state whether it is erect or scandent.

A FIELD EXPERIMENT IN THE CONTROL OF YAWS

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ONE TEXT FIGURE

Sixteen years have elapsed since the specific action of salvarsan in yaws was first demonstrated in the Philippines, and its specific action has since then been confirmed by other observations, from different parts of the Tropics. This drug, so potent and effective in the treatment of yaws, has not been used in attempts to eradicate the disease until recently. Salvarsan is wholly unsuited for routine work under field conditions. Its unsuitability has been largely overcome by the introduction of neosalvarsan, the price of which, however, was prohibitive for a time. A few years ago the Philippine Government was able to secure neosalvarsan at an almost nominal cost, for the purpose of investigating the possibility of the control of yaws.

In 1921 the Philippine Health Service opened a dispensary in Parañaque, Rizal Province, for the purpose of investigating the feasibility of extending yaws campaigns throughout the Philippines. Parañaque was chosen, because of its proximity to Manila and because it has been found to be a heavily infected town—a veritable “sore spot” to Manila, being about 6 kilometers from the southernmost boundary of the latter.

TOPOGRAPHY OF PARAÑAQUE, RIZAL PROVINCE

Parañaque lies along the eastern coast of Manila Bay. The principal streets are in close proximity to the seashore and the town itself is traversed by estuaries. Although the town is not under water at high tide or during the rainy season, yet it is

only a few meters above sea level. Indeed, the town is built along the shore of the bay, and its eastern side is limited by a branch of Parañaque River. The main occupations of the people are fishing and salt making.

EXTENT OF YAWS INFECTION

At the first house-to-house canvass, one hundred ninety-nine persons were found to be suffering from yaws in the granulomatous stage. During the first three months of treatment, forty-five more granulomatous cases were found, bringing the total up to two hundred forty-four, or 24.21 per 1,000 population, distributed in the barrios of the municipality. The reason for such heavy infection in Parañaque cannot be explained satisfactorily. Manila, with its poor population, more or less offers the same topography, habits, and hygiene, yet yaws cases are extremely rare there. The neighboring town Pasay, 2 kilometers north of Parañaque, is not so heavily infected, and only a few cases were found there. On the other hand, Las Piñas, about 3 kilometers south of Parañaque, is moderately infected. Apparently, these three towns have the same topography; the inhabitants and industries are similar, yet Parañaque is the only one that is heavily infected.

The dispensary was opened in September, 1921, and treatment was continued for three months, when all known cases were treated. The dispensary was then closed until September of the following year. It was originally hoped that it would be sufficient to operate the dispensary for a period of a few weeks, at intervals of about six months. New cases, however, were appearing so rapidly that the plan of intermittent operation was abandoned. After a partial resurvey in September, 1922, the dispensary was reopened and maintained continuously up to October 31, 1924. By that time there were no known cases existing in Parañaque. The dispensary was then closed for a period of six months and reopened in April, 1925. During the period from 1921 to 1924, two thousand five hundred forty-three cases were treated, one thousand one hundred fifty-one of which were among permanent residents and one thousand three hundred ninety-two among nonresidents, as shown in the following table:

TABLE 1.—Showing the total cases of yaws treated in Parañaque from September, 1921, to October, 1924.

Lesion.	Cases.		
	From Parañaque proper.	From neighboring towns.	Total.
Primary and secondary lesions	552	630	1,182
Tertiary lesions.....	599	762	1,361
Total.....	1,151	1,392	2,543

The majority of the tertiary group, about nine hundred, showed lesions consisting of keratosis palmaris and plantaris and bone changes. Cases of yaws, one thousand one hundred fifty-one in all, who were living in Parañaque were distributed in the different barrios of the town as shown in Table 2.

TABLE 2.—Distribution of yaws cases in barrios of Parañaque.

Barrio.	Estimated population.	Cases.
San Dionisio.....	2,975	513
La Huerta.....	1,537	152
Dongalo.....	2,293	216
Baclaran.....	3,250	155
Tambo.....	761	71
Ibayo.....	600	44
Total.....	11,466	1,151

The object of closing the clinic after several months of treatment was to learn what progress the infection would make and how soon new infections would take place, as it was believed that this information would prove useful in planning the best procedure for control. For this purpose, attention was limited to the residents of Parañaque in order to determine the number of infective cases at the time of the original survey and the number at the two subsequent resurveys, made at the reopening of the clinics.

The figures given in Tables 3 and 4 and the chart (fig. 1) show a marked fall in number of cases treated after the first period, from September to November, 1921, and a steady decline from then on to October, 1924. A much more significant

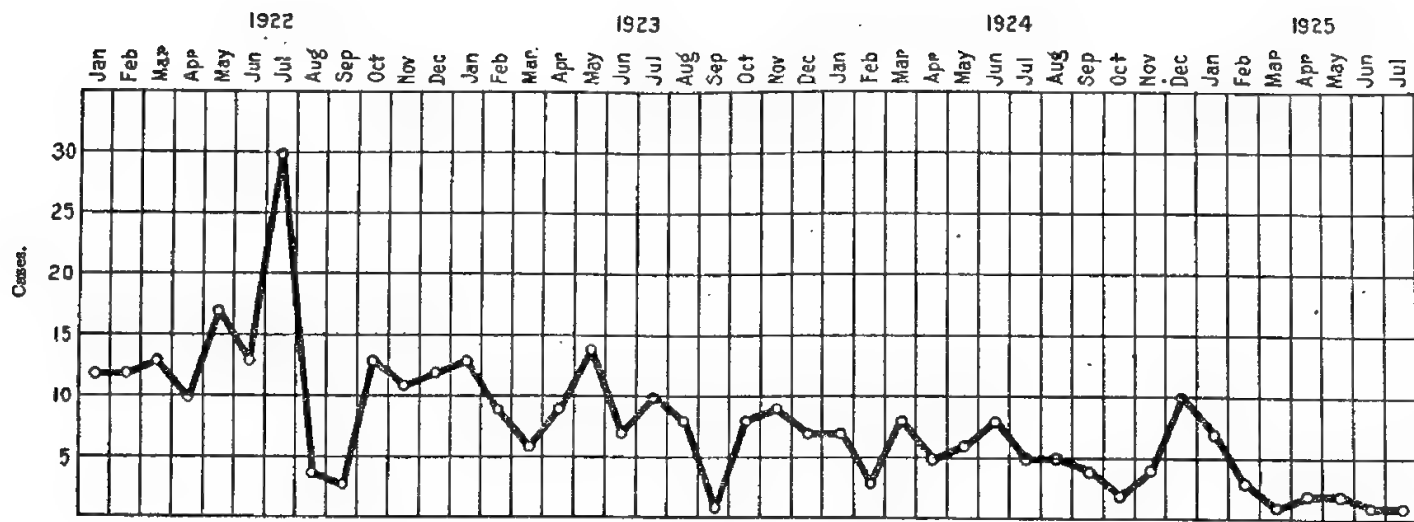


FIG. 1. New cases of yaws developing in Parañaque, by months of onset.

fall is observed after the last period, as shown by the number of cases treated from April to July, 1925.

TABLE 3.—Showing yaws cases with primary and secondary lesions, treated in Parañaque, excluding those with tertiary lesions, by months.

Month.	1921	1922	1923	1924	1925
January.....	0	0	12	16	0
February.....	0	0	15	16	0
March.....	0	0	16	18	0
April.....	0	0	17	7	19
May.....	0	0	11	0	2
June.....	0	0	13	12	1
July.....	0	0	12	0	12
August.....	0	0	7	11	-----
September.....	61	15	12	4	-----
October.....	145	28	13	17	-----
November.....	38	25	2	0	-----
December.....	0	20	10	0	-----
Total.....	244	89	129	90	34

The new cases developing each month in Parañaque are shown in Table 4. The time of onset of the disease was determined by the history of the patient and the clinical examination. The data in this table are shown more clearly in fig. 1.

TABLE 4.—Showing new cases of yaws developing in Parañaque.

Month.	1922	1923	1924	1925
January.....	12	13	7	7
February.....	12	9	3	3
March.....	13	6	8	1
April.....	10	9	5	2
May.....	17	14	6	2
June.....	13	7	8	1
July.....	30	10	5	1
August.....	4	8	5	-----
September.....	3	1	4	-----
October.....	18	8	2	-----
November.....	11	9	4	-----
December.....	12	7	10	-----
Total.....	150	101	67	17

The original estimate showed a total of two hundred forty-four granulomatous cases. Considering the care with which the survey was made and the treatment carried out, this figure may be accepted as reasonably accurate. Therefore, as seen from Table 3, three hundred forty-two new cases developed from December, 1921, to July, 1925, a period of nearly four years. This indicates

a heavier infection than was found at the beginning of the campaign; but, taking into consideration that the two hundred forty-four cases in 1921 were new infections that developed in less than two years, at the same rate we should have had around five hundred new cases had no campaign been undertaken. This shows that in opening a yaws campaign, the work should be pressed rapidly and thoroughly; in the long run, it will prove economical to do so, both in time and in money.

EPIDEMIOLOGICAL DATA

The disease has apparently no special seasonal prevalence, judging from the time the first lesions appear, as shown in Table 4. The cases, as shown by this table, are almost evenly distributed throughout the twelve months. Contact is the chief mode of infection. Multiple cases among the members of a single family are the rule in Parañaque. In one hundred ninety-nine cases studied, they were found distributed as shown in Table 5. Adults and children are equally susceptible, although more cases of primary and secondary lesions were found among children.

TABLE 5.—*Number of persons of a household that were infected with yaws.*

Families.	Cases.
49	1
28	2
10	3
7	4
3	5
2	6
0	7
1	8

TREATMENT

The dosage given was the same as is given to individuals suffering from syphilis, approximately 0.01 gram per kilogram of body weight, although a slightly higher dose was given to children and infants, who seemed to tolerate the drug better. Special care was taken to urge the patients to return for observation and for repeated injections. One or two injections cannot be counted on to effect complete recovery, though the patients were so markedly improved by one injection that the majority failed to return for further treatment. In fact, there were tertiary cases, although these were very rare, who had received eight or nine injections on account of the persistence of lesions. Table 1 shows the number of cases, including the tertiary.

It would be desirable to have a record of the result of the treatment in all cases treated at Parañaque; however, in view of the difficulties encountered, especially due to the transient habits of the fishermen which made it almost impossible to follow the entire group of patients individually throughout the period of approximately four years, one of us by careful investigation attempted to verify the results of the treatment in a representative and unselected number of patients. The findings, with the number of injections given in each case, are shown in Table 6.

TABLE 6.—Results of treatment, showing the number of injections in a representative number of cases from Parañaque.

Injections.	Cases recovered.	Cases improved.	Relapses.	Cases not recovered.
1.....	140	0	1	3
2.....	102	0	2	0
3.....	43	3	2	0
4.....	12	1	3	1
5.....	1	0	2	0
6.....	2	0	0	0
7.....	1	0	0	0
Total.....	301	4	10	4

As shown by Table 6, of three hundred nineteen cases followed up three hundred one, or 94.35 per cent, recovered and eighteen, or 5.65 per cent, improved, relapsed, or remained uncured. It must be said that six tertiary cases are included among the eighteen cases that were not cured.

After the dispensary had been closed for six months, thirty-four new cases were treated from April, 1925, to July 31, 1925. Of these new cases only thirty-one were new infections that occurred after the closing of the clinic, and the remaining three appear to have developed the eruptions before the clinic was closed. All showed only a primary granuloma, no secondary lesions having developed. The appearance of thirty-one new infections (see Table 4) in nine months shows that yaws, though essentially a chronic disease, can spread with fair rapidity. This is all the more striking when we consider that no recognizable focus of infection was present in Parañaque on October 31, 1924. Intermittent operation of a dispensary is obviously desirable, for the sake of economy; but our results show that, when the disease has been brought under control in a district once heavily infected, caution must be exercised in determining the length of time that treatment may be entirely suspended.

RELAPSES

Considering that a high proportion of cases received only one or two injections, the number of relapses is encouragingly small. There were only eighteen patients who showed recurrence or persistence of clinical symptoms among the three hundred nineteen who were reexamined after treatment. Relapse commonly occurs within the first twelve months following the last injection, although it may occur after the first year. Table 7 shows the length of time, in months, after which relapses occurred in the ten cases recorded.

TABLE 7.—*Showing the length of time after which relapse occurred.*

Time after which relapse occurred.	Patients who received—				Total.
	1 injection.	2 injections.	3 injections.	4 injections.	
<i>Months.</i>					
0 to 6.....	1	2	1		4
7 to 12.....	^a 3	1		^b 1	5
13 to 18.....					
19 to 24.....	1				1
Total.....	5	3	1	1	10

^a One case relapsed twice, each time, with one injection, in the same length of time (seven to twelve months).

^b Relapsed twice; the first time, with one injection, after six months, and the second, with four injections, after eight months.

COST OF TREATMENT

This work in yaws was carried out entirely by the medical officers regularly employed by the Philippine Health Service, in addition to their ordinary duties. The increase in the expenses occasioned by the treatment of the yaws cases, therefore, consisted merely in the expenditures for neosalvarsan and for the apparatus and material required in its administration. It was estimated that a clinic could be established for the minimum initial cost of 50 pesos¹ for equipment and an average cost of 1.20 pesos for neosalvarsan and other materials per patient.

OUTLOOK FOR THE CONTROL OF YAWS

It is not feasible at present to obtain even an approximate census of the yaws cases in the Philippines. A provisional survey showed the presence of at least forty thousand cases. There are probably three times this number and they are

¹ One peso Philippine currency equals 50 cents United States currency.

widely scattered throughout the Archipelago, from Batanes to Mindanao. Fortunately, however, they are unequally distributed and, of the forty thousand shown in the provisional survey, at least twenty-nine thousand were concentrated in thirteen centers; namely, Agusan, Batanes, Batangas, Ilocos Norte, Bulacan, Camarines Sur, Catanduanes, Cotabato, Ilocos Sur, Pangasinan, Rizal, Sulu; and Zamboanga Provinces, as shown in Table 8.

TABLE 8.—*Showing the number of cases of yaws treated with neosalvarsan in thirty-three provinces during 1923 and 1924.*

Province.	1923	1924	Total.
Agusan.....	551	857	1,408
Albay.....	3	1	4
Antique.....	28		28
Bataan.....	34	39	73
Batanes.....	337	790	1,127
Batangas.....	272	541	813
Bulacan.....	917	776	1,693
Cagayan.....		108	108
Camarines Sur.....	1,809		1,809
Catanduanes.....	77	1,241	1,318
Cavite.....		203	203
Cebu.....	2		2
Cotabato.....		5,834	5,834
Davao.....	306		306
Ilocos Norte.....	298	1,315	1,613
Ilocos Sur.....	240	257	497
Laguna.....	16		16
Lanao.....		17	17
La Union.....	7	6	13
Leyte.....		133	133
Mindoro.....		11	11
Misamis.....		33	33
Mountain.....	4	293	297
Nueva Ecija.....		82	82
Palawan.....	1		1
Pangasinan.....	423	1,630	2,103
Rizal.....	3,532	411	3,943
Samar.....		8	8
Sulu.....	524	5,489	6,013
Surigao.....	10	137	147
Tarlac.....	20	103	123
Zambales.....	718	10	728
Zamboanga.....	30	506	536
Total.....	10,159	20,881	31,040

With the progress of the treatment at Parañaque, patients in other districts became insistent in their demands for treatment. The immediate results at Parañaque were so encouraging that additional clinics were opened in some of the more heavily in-

fectured localities. From 1921 to December 31, 1924, thirty-two thousand thirty-seven cases have been treated. Obviously, it will require many years yet to reach the outlying districts. Moreover, it is evident that the spread of yaws can be kept under control only at the price of persistent vigilance and intensive campaigning; otherwise, new cases will soon appear and the disease will regain a foothold. One of the most hopeful features is the quick and enthusiastic response on the part of the public. In Parañaque, a remarkable change in the attitude of the people has taken place in a short space of time. Only four, or even three, years ago the residents there accepted yaws uncomplainingly, as a necessary and unavoidable feature of life. Now the occurrence of a case of yaws is looked upon as a misfortune that cannot and must not be tolerated. This factor alone will go far toward assuring the eventual eradication of yaws in this community.

Although the results of treatment by neosalvarsan are extraordinarily brilliant, one desideratum remains; namely, a drug that can be used easily and painlessly by intramuscular injection. In the clinics in the Philippines, neosalvarsan is often used intramuscularly in infants, but only by intravenous injection in older patients. Of the other drugs used in yaws, Gilks(1) and Guerrero, Rosal, and Fernandez(2) have obtained excellent results with sodium potassium bismutho-tartrate by intramuscular injection. With this drug Gilks reports that the local reactions are about as severe as with neosalvarsan used intramuscularly. Moreover, severe stomatitis sometimes occurs.

Steadily increasing attention is being given to the control of yaws throughout the tropical world. In Granada,(3) at the close of 1922, nearly thirteen thousand cases were treated in a population of about sixty-six thousand. Gilks, in the Kenya Colony, East Africa, reports the treatment of twenty-four thousand two hundred thirty-three cases in 1922. By far the most extensive work has been conducted in the Dutch East Indies. Work was begun actively in 1920 and, by the end of the first half of the year 1923, the number of patients treated had reached the enormous figure of eight hundred ninety thousand. Neosalvarsan was used, each patient receiving only a single injection.

The opinion of all these workers is unanimous; namely, that yaws can be brought under control by destruction of the causative agent, *Treponema pertenue*, through treatment of the patients.

SUMMARY

1. Yaws has been brought under control in Parañaque, a district that has been heavily infected from time immemorial. During approximately four years one thousand one hundred fifty-one cases were treated.

2. The development of new cases of yaws in infected communities is moderately rapid. In Parañaque, three hundred forty-two new cases developed in three years. After all known cases were treated, thirty-one new cases developed in nine months.

3. Intermittent operation of yaws dispensaries is not a satisfactory procedure for the control of the disease in very heavily infected communities.

4. Intensive treatment and persistent vigilance, so as to assure complete recovery of existing cases, is the most important factor in the control of the disease.

REFERENCES

1. GILKS, J. L. *Trans. Roy. Soc. Trop. Med. and Hyg.* 17 (1923) 277.
2. Report from the Colonial Office, *Trop. Dis. Bull.* 20 (1923) 843.
3. WINKEL, CH. W. F. *Mededeelingen van den Burgerlijken Geneeskundigen Dienst in Nederlandsch Indie*, Part 3 (1923) 213.

ILLUSTRATION

TEXT FIGURE

FIG. 1. Chart showing new cases of yaws developing in Parañaque, by months of onset.

A SEROLOGICAL ESTIMATE OF THE EFFICACY OF NEOSALVARSAN IN THE TREATMENT OF YAWS IN A FIELD DISPENSARY ¹

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Within the past five years the treatment of yaws was begun on an extensive scale in many parts of the Tropics. The campaigns for the control of yaws have developed so rapidly that the work is already assuming world-wide proportions. The success of these campaigns has been due to various factors, more especially to the facility with which neosalvarsan can be injected, even under field conditions; to the unfailing popularity of the clinics with yaws patients; and also, in no small measure, to the enthusiasm of the physicians and attendants in charge of the clinics.

The very brilliancy of the effects of a single injection of neosalvarsan carries with it some measure of disadvantage, in that many patients do not bother to return for continued treatment. Accurate information concerning the incidence of relapses or reinfections has been difficult to secure, in view of the very nature of the conditions under which the field clinics are operated. Under the direction of Dr. L. Lopez-Rizal, of the Philippine Health Service, a field clinic was conducted at Parañaque, in which it was possible to follow the patients during a period of several years. In this clinic, Lopez-Rizal, Gutierrez, and Fernandez ² noted clinical evidence of relapses in almost 6 per cent of three hundred nineteen patients who were treated during the granulomatous stage of the disease.

In the work the Wassermann reaction was used to determine the efficacy of treatment under the purely practical circumstances that existed in the field work at Parañaque. Of the five hundred fifty-two patients treated in the granulomatous stage at Parañaque, one hundred one were taken without se-

¹ From the department of pathology and bacteriology, College of Medicine, and the department of laboratories, Philippine General Hospital.

² Antea, 437.

lection for the Wassermann test. The majority of these patients were children of school age. The treatment they received varied from one to five intravenous injections of neosalvarsan. The lapse of time between the last treatment and the examination of the blood varied from three months to three and one-half years.

The Wassermann reaction was carried out according to the technic described by Hinton.³ Two units of antishoop-rabbit amboceptor and two units of complement of guinea-pig serum were used. Sheep cells were employed in approximately 5 per cent suspension, the uniformity of the suspension being controlled by a color standard. The only antigen used was a cholesterinized alcoholic extract of beef heart.

As emphasized by Goodpasture and de Leon,⁴ it may be considered as established that the Wassermann reaction is constantly and strongly positive in the active secondary stage of yaws. Consequently, in the cases reported in this paper it can be safely assumed that the Wassermann reaction was positive before the treatment with neosalvarsan. For the correct interpretation of the following results it is important to note that Goodpasture and de Leon found that, in patients under treatment with neosalvarsan, the Wassermann reaction did not disappear coincidently with the healing of the skin lesions. However, after the cessation of treatment, the reaction gradually weakened and eventually became negative. Therefore, it is usually necessary to allow several months to elapse after the last injection of neosalvarsan, in order to determine the final effect of treatment as judged by the Wassermann reaction.

Of the one hundred one patients who were tested, eighty-three, or 82 per cent, gave entirely negative results. In eight cases, a trace of inhibition (+) was observed, but in our experience this degree of inhibition is almost without significance in this community. It so happened that a ++ reaction (50 per cent hæmolysis) was observed in only one case. There were six patients giving a +++ result (75 per cent inhibition) and three who showed complete inhibition (++++). Thus, there were only ten cases (10 per cent) giving a definitely positive Wassermann test.

For the convenience of the reader, the patients are grouped in the tables according to the result of the Wassermann reac-

³ Am. Journ. Syph. 4 (1920) 598.

⁴ Philip. Journ. Sci. 22 (1923) 221.

tion, and arranged according to the period of time elapsing between the last treatment with neosalvarsan and the date of the Wassermann test. All of the patients who gave an entirely negative reaction are recorded in Table 1.

TABLE 1.—*Record of patients giving a negative Wassermann reaction.*

Serial No.	Date of treatment with neosalvarsan.			Date of Wassermann test.	Interval between treatment and Wassermann test.
	First injection.	Second injection.	Third injection.		
1.....	Oct. 19, 1924	-----	-----	Feb. 6, 1925	Months. 3½
2.....	Sept. 20, 1924	-----	-----	do.	5
3.....	Jan. 9, 1920	Feb. 5, 1924	^a Feb. 19, 1924	Mar. 5, 1925	5½
4.....	Oct. 7, 1922	Aug. 11, 1923	June 14, 1924	Apr. 6, 1925	9½
5.....	Sept. 22, 1921	Oct. 3, 1925	-----	Dec. 2, 1924	10
6.....	Oct. 9, 1920	Oct. 19, 1922	^b Sept. 22, 1923	Nov. 13, 1924	13
7.....	Oct. 12, 1922	Apr. 28, 1923	-----	Apr. 6, 1925	13½
8.....	Dec. 22, 1923	-----	-----	Feb. 2, 1925	13½
9.....	Nov. 7, 1922	Dec. 21, 1922	Apr. 16, 1923	Apr. 6, 1925	13½
10.....	Nov. 27, 1923	-----	-----	Mar. 23, 1925	15½
11.....	Nov. 11, 1923	Jan. 6, 1923	-----	Apr. 6, 1925	17
12.....	July 17, 1923	-----	-----	Nov. 21, 1924	17
13.....	Sept. 26, 1921	July 10, 1923	-----	Feb. 2, 1925	17½
14.....	May 3, 1923	-----	-----	Nov. 21, 1924	18½
15.....	Jan. 11, 1923	Aug. 11, 1923	Aug. 18, 1923	Apr. 6, 1925	19½
16.....	Jan. 29, 1923	-----	-----	Dec. 2, 1924	22
17.....	Oct. 26, 1922	May 10, 1923	-----	Apr. 6, 1925	22½
18.....	Nov. 9, 1921	Dec. 12, 1922	-----	Nov. 21, 1924	23½
19.....	Jan. 25, 1923	Feb. 1, 1923	^c Feb. 8, 1923	Feb. 2, 1925	23½
20.....	Oct. 14, 1922	-----	-----	Dec. 2, 1924	25½
21.....	Sept. 23, 1922	-----	-----	do.	26
22.....	Oct. 26, 1922	Nov. 4, 1922	Dec. 9, 1922	Feb. 6, 1925	26
23.....	Oct. 21, 1922	Dec. 23, 1922	-----	Mar. 5, 1925	27
24.....	Dec. 2, 1922	-----	-----	do.	27
25.....	Oct. 14, 1922	Nov. 4, 1922	-----	Feb. 6, 1925	27
26.....	Nov. 21, 1922	Dec. 5, 1922	-----	Mar. 16, 1925	27½
27.....	Oct. 19, 1922	-----	-----	Feb. 6, 1925	27½
28.....	Dec. 5, 1922	-----	-----	Mar. 23, 1925	27½
29.....	Oct. 12, 1923	-----	-----	Feb. 6, 1925	27½
30.....	Nov. 4, 1923	Nov. 11, 1923	Nov. 21, 1922	Mar. 23, 1925	28
31.....	Oct. 24, 1922	-----	-----	Mar. 5, 1925	28½
32.....	Oct. 21, 1922	-----	-----	do.	28½
33.....	Oct. 17, 1922	-----	-----	do.	28½
34.....	Oct. 3, 1921	Nov. 7, 1921	Oct. 24, 1922	Mar. 16, 1925	28½
35.....	Oct. 19, 1923	Nov. 2, 1922	-----	Mar. 23, 1925	28½
36.....	Oct. 14, 1922	-----	-----	Mar. 5, 1925	28½
37.....	Sept. 26, 1922	Oct. 5, 1922	-----	Mar. 16, 1925	29½
38.....	Sept. 22, 1922	Oct. 7, 1922	-----	Mar. 23, 1925	29½
39.....	Nov. 14, 1922	-----	-----	Mar. 5, 1925	29½
40.....	-----	-----	-----	Mar. 23, 1925	^d 30

^a Fourth injection, September 20, 1924; fifth injection, September 30, 1924.

^b Fourth injection, October 6, 1923.

^c Fourth injection, February 15, 1923.

^d Approximate; exact record of treatment not available.

TABLE 1.—Record of patients giving a negative Wassermann reaction—Ctd.

Serial No.	Date of treatment with neosalvarsan.			Date of Wassermann test.	Interval between treatment and Wassermann test.
	First injection.	Second injection.	Third injection.		
41.....				Apr. 6, 1925	<i>Months.</i> d 30
42.....	Sept. 26, 1922	Oct. 12, 1922		do.	30½
43.....	Nov. 8, 1921	Nov. 17, 1921		Nov. 13, 1924	36½
44.....	Sept. 12, 1921	Oct. 3, 1921		Oct. 13, 1924	36½
45.....	Sept. 19, 1921	Oct. 3, 1921		do.	36½
46.....	Nov. 3, 1921			Nov. 13, 1924	36½
47.....	Sept. 12, 1921	Sept. 26, 1921		Oct. 13, 1924	36½
48.....	Oct. 27, 1921			Nov. 13, 1924	36½
49.....	Sept. 15, 1921	Oct. 27, 1921		do.	36½
50.....	Oct. 19, 1921	Oct. 26, 1921		do.	36½
51.....	Oct. 31, 1921			Nov. 21, 1924	36½
52.....	Oct. 27, 1921			do.	36½
53.....	Oct. 31, 1921			do.	36½
54.....	Sept. 15, 1921			do.	36½
55.....	Sept. 26, 1922			do.	36½
56.....	Oct. 29, 1921			Dec. 2, 1924	37
57.....	Nov. 3, 1921			do.	37
58.....	Oct. 10, 1921			Nov. 13, 1924	37
59.....	Sept. 12, 1921			Dec. 2, 1924	37½
60.....	Sept. 19, 1921	Oct. 3, 1921		Nov. 13, 1924	37½
61.....	Sept. 12, 1921	do.		Nov. 21, 1924	37½
62.....	Sept. 19, 1921	do.		do.	37½
63.....	Sept. 26, 1921			do.	37½
64.....	Sept. 10, 1921	Sept. 29, 1921		Dec. 2, 1924	38
65.....	Sept. 12, 1921			Nov. 13, 1924	38
66.....	Sept. 22, 1921			Dec. 2, 1924	38½
67.....	do.			do.	38½
68.....	Oct. 26, 1921			Feb. 2, 1925	39
69.....	Oct. 27, 1921			Mar. 5, 1925	40
70.....	Sept. 28, 1922			Apr. 6, 1925	40
71.....	Nov. 10, 1921			Mar. 16, 1925	40½
72.....	Oct. 27, 1921	Nov. 16, 1921		Mar. 23, 1925	40½
73.....	Oct. 31, 1921			Mar. 16, 1925	40½
74.....	Oct. 19, 1921	Oct. 31, 1921		do.	40½
75.....	Oct. 13, 1921	Oct. 27, 1921		do.	40½
76.....	Oct. 31, 1921			Mar. 23, 1925	40½
77.....	Oct. 24, 1921			Mar. 16, 1925	40½
78.....	Oct. 20, 1921			Mar. 23, 1925	41
79.....	Oct. 24, 1921			do.	41
80.....	Sept. 26, 1921	Oct. 25, 1921	Oct. 31, 1921	Apr. 6, 1925	41
81.....	Oct. 13, 1921			Mar. 16, 1925	41
82.....	Sept. 29, 1921	Oct. 6, 1921		do.	41½
83.....	Sept. 22, 1921	Oct. 3, 1921		Mar. 23, 1925	41½

^a Approximate; exact record of treatment not available.

Of the eighty-three patients giving an entirely negative result forty-three, or 51+ per cent, received only one injection and twenty-eight received two injections, with an interval usually of one to two weeks between the injections. Occasionally this interval was as long as three years. Only ten, or 12 per cent, of these negative cases received more than two injections. Seven were injected three times, two were given four injections, and one patient was given five injections. In two cases (40 and 41) the exact number of injections could not be ascertained.

The patients who showed a positive Wassermann reaction were retested after an interval of several months, and they were also examined clinically. The results are shown in Table 2.

There were eighteen patients who gave a positive Wassermann test. Eight of this group gave a very weak Wassermann reaction (+). Only one of the eight received treatment in the interval between the first and the second blood tests. On repetition of the Wassermann test five of the eight patients had become negative, and one showed a three-plus reaction. Two members of this group (the one-plus group) could not be seen for a second Wassermann test and for clinical examination. As seen in Table 2, all of the patients examined clinically in the one-plus group gave negative findings. In case 89, whose one-plus reaction was obtained twenty-nine months after the single injection, the blood showed a three-plus reaction four months after the first test, or thirty-two months after the treatment. Clinically this case was entirely negative at the time the blood for the second test was taken.

There was only one patient (92) who gave a two-plus reaction. Four and one-half months after the first Wassermann reaction on this case the blood became three-plus, and fresh ulcers on both legs were seen. This patient and all of those in the following (three-plus) group showed positive clinical findings, except in one instance (case 93). The clinical manifestations were in the form of keratosis plantaris with or without ulcers or fissures, enlarged epitrochlear glands, or fresh ulcers. As shown in the second blood examination, no patient in the three-plus group showed any change in the strength of the Wassermann reaction after an interval of from one and one-half to seven months. It is important to note that all of these patients, including the single case that gave a two-plus reaction, had received only a single injection.

TABLE 2.—Record of patients giving positive Wassermann reaction.

Serial No.	Date of treatment with neosalvarsan.		First Wassermann test.		Interval between last treatment and first Wassermann test.	Second Wassermann test.		Interval between Wassermann tests.	Remarks.
	First injection.	Second injection.	Result.	Date.		Result.	Date.		
84	May 26, 1923	-----	+	Feb. 2, 1925	Months.	—	July 3, 1925	Months.	Negative clinically, July 3, 1925. Do.
85	Sept. 22, 1921	* Oct. 3, 1921	+	Oct. 13, 1924	20½	—	do.	5	
86	Nov. 11, 1922	Dec. 7, 1922	+	Feb. 6, 1925	22½	—	-----	8½	
87	Nov. 7, 1922	-----	+	do.	26	—	July 3, 1925	5	Patient could not be located for clinical examination and second examination of blood.
88	Sept. 28, 1922	^b Dec. 5, 1922	+	Apr. 6, 1925	28	—	June 30, 1925	2	Negative clinically, July 3, 1925.
89	Oct. 19, 1922	-----	+	Mar. 16, 1925	28½	+++	July 17, 1925	4	Negative clinically, June 30, 1925.
90	Sept. 15, 1921	-----	+	Nov. 13, 1924	37½	-----	-----	-----	Negative clinically, July 17, 1925.
91	Nov. 4, 1922	Nov. 18, 1922	+	Feb. 2, 1925	38½	—	July 3, 1925	5	Patient could not be located for second blood test and clinical examination.
92	Oct. 14, 1922	-----	++	Feb. 6, 1925	27½	+++	June 30, 1925	4½	Negative clinically.
93	Sept. 19, 1921	-----	+++	Nov. 21, 1924	38	+++	July 3, 1925	7½	Fresh ulcers on both legs, June 30, 1925.
94	Nov. 11, 1922	-----	+++	Feb. 2, 1925	38½	+++	May 19, 1925	3½	Negative clinically, June 30, 1925.
95	Oct. 18, 1922	-----	+++	do.	39½	+++	do.	3½	Epiitrochlear glands enlarged, May 15, 1925.
96	Oct. 31, 1921	-----	+++	Apr. 6, 1925	41	+++	do.	1½	Keratosi plantaris, May 15, 1925.
97	Sept. 19, 1921	-----	+++	Mar. 16, 1925	41½	+++	do.	2	Keratosi plantaris with ulcers, May 15, 1925.
98	Sept. 22, 1921	-----	+++	Mar. 23, 1925	42	+++	do.	2	Keratosi plantaris with ulcers in big toes, May 15, 1925.
99	Oct. 14, 1921	* Oct. 17, 1922	++++	Mar. 16, 1925	25½	++++	May 8, 1925	3½	Keratosi plantaris with fissures, May 15, 1925.
100	Oct. 19, 1922	-----	++++	Feb. 2, 1925	27½	++++	May 19, 1925	3½	Apparently negative clinically, May 5, 1925.
101	Oct. 12, 1922	Oct. 19, 1922	++++	Mar. 16, 1925	29	++++	July 3, 1925	3½	Enlarged epitrochlear glands; fresh ulcers on both legs.

* Third injection, November 21, 1922; fourth injection, November 28, 1922.

^b Third injection, July 2, 1925; fourth injection, July 9, 1925; fifth injection, July 16, 1925.^c Third injection, October 24, 1922.

There are three cases in the last group (four-plus group). All of them showed complete inhibition in both the first and the second blood examinations. In all of them it happened that the second test was made a little more than three months after the first examination of the blood. In two of these cases (99 and 101) no clinical manifestations could be seen. In one patient (100) enlarged glands and fresh ulcers were found when the blood for the second test was taken. Incidentally, only one injection was given to this case while cases 99 and 101 had received two and three injections, respectively.

In Table 3 the results of the Wassermann test are arranged according to the number of injections that the patients received. These injections were given at short intervals, making a continuous course of treatment, except in eight instances.

TABLE 3.—*Classification of Wassermann results according to the number of injections given in treatment.*

Injections per patient.	Total cases.	Wassermann reaction.				
		Negative cases.	+ cases.	++ cases.	+++ cases.	++++ cases.
1.....	55	43	4	1	6	1
2.....	31	28	2			1
3.....	8	7				1
4.....	3	2	1			
5.....	2	1	1			

From Table 3 it is seen that a single injection of neosalvarsan was followed by a completely negative Wassermann reaction in forty-three of fifty-five cases (78 per cent). This result is very striking, but it cannot be accepted as final proof that the infection with treponemata had been entirely eradicated in all of the cases giving a negative Wassermann reaction. The interval of time elapsing between the injection with neosalvarsan and the examination of the blood varied from three and one-half to forty-one and two-thirds months. Of the thirty-one patients who received two injections, twenty-eight gave an entirely negative reaction and only one gave a definitely positive test.

The dosage of neosalvarsan for these patients varied from 500 or 600 milligrams for adults to 75 milligrams for infants 2 years or less of age. Patients of intermediate ages were given proportionate amounts.

SUMMARY

1. The Wassermann reaction in one hundred one yaws patients treated with neosalvarsan at the field clinic in Parañaque was made three months to three years after the cessation of treatment.

2. Eighty-three of these, or 82 per cent, gave an entirely negative reaction. Ten of them gave decidedly positive tests, two-plus, three-plus, or four-plus.

3. Of the eighty-three patients giving a negative reaction forty-three, or 51 per cent, received only one injection.

4. Fifty-five of the one hundred one patients included in this report received only one injection. Of these fifty-five cases, forty-three were negative and four gave a one-plus reaction.

5. Of the eighteen patients giving a positive Wassermann reaction, seven showed clinical manifestations of yaws. One of these is the single case giving a two-plus reaction, five are in the three-plus group, and one is in the four-plus group.

INVESTIGATION OF IMMUNITY IN YAWS¹

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ONE PLATE

The question of immunity in yaws has been investigated by the inoculation of patients who have been cured, or at least apparently cured, with injections of neosalvarsan. In employing this procedure as a method for the study of immunity one encounters the difficulty of establishing absolutely that treatment by neosalvarsan has entirely eradicated the treponemata. Consequently, it becomes difficult to determine whether resistance to reinfection is due to an active immunity or to the persistence of low-grade infection. However, since the inoculations were made in patients, the results, regardless of their theoretical interpretation, are immediately applicable in the practical problem of the control of yaws. In 1922 this method was employed for the study of a small group of cases.² Six months after treatment with neosalvarsan, four patients were inoculated by implanting a small fragment of a yaws granuloma in an incision in the skin. One of the patients was readily susceptible, but the other three were more or less refractory to reinfection. Two of the four cases developed lesions of sufficient extent to require treatment with neosalvarsan.

After an interval of more than two years the susceptibility of these four patients to yaws was tested again by reinoculation. They had received no further treatment in the meantime, and they continued to live in Parañaque, a district thoroughly infested with yaws. In the following description of our results the numbers of the cases agree, of course, with

¹ From the Bureau of Science, Manila.

² Sellards, A. W., and E. W. Goodpasture, *Philip. Journ. Sci.* 22 (1923) 233.

those used in the previous report. These patients were discharged from observation in July, 1922, and were next seen in September, 1924. At the latter date, none showed any lesions of the skin nor any signs of involvement of the lymphatic glands or the bones. The Wassermann reaction was entirely negative in three of the cases and in one (No. 4) there was a mere trace of inhibition of hæmolysis. A month later the Wassermann reaction was repeated, with the same result.

On October 11, 1924, these patients were reinoculated with yaws, by implanting pieces of tissue, rich in treponemata, in a skin incision over the deltoid. These fragments of tissue were selected from an early yaw, before the crust had formed. As a precautionary measure, smears were examined for contaminating organisms, particularly the streptococci, but none were found. The results of the reinoculation varied only in detail from those shown in these patients in 1922. The data are summarized in Table 1.

TABLE 1.—*The reinoculation of yaws in cases treated with neosalvarsan.*

Case No.	Preliminary record of patient.			
	Duration of disease.		Wassermann reaction before treatment.	Date of treatment with neosalvarsan.
	Yrs.	mos.		1921
1.....		3	++++	September-October.
2.....	1	(++)	++++	Do.
3.....	2	(—)	++++	Do.
4.....		8	++++	Do.

Case No.	First reinoculation with yaws.				
	Date.	Wassermann reaction before first reinoculation.	Clinical results.	Wassermann reaction after first reinoculation.	Treatment with neosalvarsan.
1....	March 9, 1922	0	Typical granuloma, early secondary lesions after five weeks.	April 6, 0	April, 1922.
2....	do.	±	No typical lesion.	May 16, +	None.
3....	do.	0	do.	March 30, 0	None.
4....	do.	0	Granuloma, clinically atypical, no secondary lesions after four months.	March 30, ±	July, 1922.

TABLE 1.—*The reinoculation of yaws in cases treated with neosalvarsan—Continued.*

Case No.	Second reinoculation with yaws.			
	Date.	Wassermann reaction before second reinoculation.	Clinical results.	Wassermann reaction after second reinoculation.
	1924			1924-1925
1....	October 11	0	Typical granuloma, secondary lesions in scalp after one and three-fifths months.	November 29, ++.
2....	.....do.....	0	No lesions.....	April 30, ++.
3....	.....do.....	0	Abortive atypical reaction.....	April 30, ++.
4....	.....do.....	±	.....do.....	June 30, 0.

For the interpretation of these results one must remember that, as far as we know, there is no natural immunity to yaws. With good material and with a little technical care, normal individuals can be inoculated successfully without difficulty. It is important to note (see Table 1) that in the second reinoculation of these patients, as in the first, there were no absolutely negative reactions. The results of the second reinoculation require some detailed description. The intervals of time are dated from the inoculation of October 11, 1924. In the first case, one week after inoculation, the faint line where the skin incision had been made was very slightly hyperæmic. At the end of the second week, the line of the incision was slightly elevated, and at its center there was a yellow spot the size of a pinhead, surrounded by a narrow zone (2 millimeters) of hyperæmia. This enlarged rapidly, appearing one week later as an oval lesion, 5 millimeters long. At the end of the fifth week after inoculation there was a characteristic yaw, 1.5 centimeters in diameter, with a yellow crust. The Wassermann reaction one week later showed about 50 per cent hæmolysis (++).³ In the succeeding weeks, this primary yaw, instead of showing typical rapid growth, remained almost stationary and even regressed slightly at some places along its margin but advanced slowly at other places.

³ Throughout this paper the Wassermann reactions are reported as follows: +, almost complete hæmolysis; ++, about 50 per cent hæmolysis; + + +, about 75 per cent inhibition; + + + +, complete or almost complete inhibition of hæmolysis.

In as much as no secondary lesions had developed at the end of seven weeks after inoculation, we performed a subinoculation. The condition of the primary yaw at this date is shown in Plate 1, fig. 1. A fragment of the primary yaw showing typical treponemata in the dark field was inoculated, as before, in skin incisions over the deltoid on the same arm and on the opposite arm. These healed promptly without even the development of any hyperæmia. The failure of this autoinoculation must not be confused with the successful autoinoculations obtained in patients during the initial attack of yaws. After an interval of three and one-third months the primary yaw showed some signs of regression, and the epidermis surrounding it was roughened and depigmented, the papillæ standing out prominently (Plate 1, fig. 2).

After five months, there was still no secondary eruption. At the end of six months, however, we found numerous typical granulomata limited almost exclusively to the scalp. By way of contrast, in the spontaneous infection of this patient, the secondary eruption appeared about one month after the mother yaw was noticed, the granulomata showing the usual distribution over the body, appearing on the face, neck, in the right axilla, and over the chest, abdomen, and legs.

The secondary eruption in the scalp was accompanied by the appearance over the body of an unusual macular exanthem. This will be discussed more fully in a subsequent paper.⁴ There was also a general enlargement of the superficial lymphatic glands, particularly the posterior cervical and auricular glands. The infection was terminated at this stage by treatment with neosalvarsan.

To summarize, the points of interest in the first case are the prompt appearance of a typical yaw at the site of inoculation; its subsequent slow growth; the failure of autoinoculation; and the very late appearance of secondary granulomata, atypical in their distribution and accompanied by a macular rash.

In the second patient, the inoculation was followed by prompt healing without hyperæmia and with no elevation of the epidermis along the line of the incision. Locally, therefore, the result was entirely negative. Six and one-half months after inoculation, the blood showed a ++ Wassermann reaction. This result raises the question of the possible development of a low-grade infection insufficient to produce any clinical signs or

⁴ Postea, 478.

symptoms. This patient is still under observation. He is in robust health, quite unlike his general appearance when he was first seen four years ago, toward the end of the secondary stage of his spontaneous attack of yaws. The development of a positive Wassermann reaction suggests an analogy with those yaws patients in whom the granulomata have disappeared spontaneously but in whom the blood continues to show a positive Wassermann reaction for several years.

The third patient showed comparatively little reaction at the site of inoculation. At the end of two weeks, in the line of the skin incision there was a slightly elevated ridge, 2 millimeters long and 1 millimeter wide. This was slightly pink at the edges. One week later this ridge had increased in size (5 by 1.5 millimeters); the rete Malpighii in it were prominent. There was a white zone of depigmentation at the edges and this, in turn, was surrounded by a pink areola. In the succeeding weeks, this lesion regressed slowly, becoming dry without definite desquamation; it disappeared completely by the end of the seventh week after inoculation. A blood specimen taken six and one-half months after inoculation showed a positive Wassermann reaction (+ +).

The fourth case showed a definite local change at the site of inoculation that was not granulomatous in character. Indeed, it was unlike any of the ordinary lesions of yaws, but resembled the lesion developing in case 3, though more intense. It also had certain features in common with the zone of depigmentation which eventually appeared around the granuloma developing in case 1 (Plate 1, fig. 2). The reaction started promptly. One week after inoculation, in the middle of the skin incision, there was a yellow spot the size of a pinhead. The epidermis around this was slightly raised and surrounded by an irregular pinkish areola. For the next three weeks, this lesion increased slowly in size and then began to regress. One week later, that is, five weeks after inoculation, the lesion was dry and desquamating, but was surrounded by an irregular zone, 1 to 2 centimeters in width, of hard white papules of pinhead size. These were scalelike in appearance and, when firmly scraped, did not leave any bleeding points. The appearance at the end of the seventh week is shown in the accompanying photograph (Plate 1, fig. 3). This lesion, surrounding the original inoculation, regressed slowly without any evident desquamation; by the end of the tenth week after inoculation it had diminished markedly, but traces of the lesion were still

present three and one-third months after inoculation (Plate 1, fig. 4). This patient will be discussed more fully in the consideration of some of the unusual skin lesions of yaws.⁵ The Wassermann reaction, eight and one-half months after inoculation, was negative.

DISCUSSION

Three of these four cases (Nos. 2, 3, and 4) had been infected with yaws for a fairly long period at the time of their first course of treatment with neosalvarsan, and they showed distinct resistance to reinfection upon experimental inoculation with yaws. It is ordinarily assumed that thorough treatment of a yaws patient with neosalvarsan accomplishes an actual cure of the infection, but this opinion may be open to question in view of the resistance to reinfection that was observed in these treated patients. If it could be established that the treatment resulted in complete destruction of the *treponemata*, then this resistance to reinfection would afford satisfactory evidence of the development of acquired immunity to yaws in man. At present, no final decision is possible. To workers who are familiar with syphilis only, the temptation is strong to ascribe this resistance to a latent infection with yaws. However, the weight of evidence appears to us to be in favor of an active immunity. Yaws is a disease *sui generis*, and many facts do not apply to it which are well demonstrated for syphilis. *Treponema pertenue* is but slightly invasive, as compared with *Treponema pallidum*, and it responds very readily to therapeutic measures. Thorough treatment of these four cases with neosalvarsan restored the Wassermann reaction to normal and resulted in complete freedom from clinical signs or symptoms for more than two years. This period of time is by no means sufficient to insure freedom from a possible relapse. Yet, until there is evidence to the contrary, it seems to us that the burden of proof rests with those who would maintain that each of the three patients who were resistant to inoculation carried a latent infection.

Comparing the results of the first and the second reinoculations, each of the four patients on the second test showed a little increase in his resistance to reinfection. This suggests that the first reinoculation resulted in a slight increase in the degree of immunity. At least, this view seems more natural than the alternative assumption of an increase in the "degree of latent infection."

⁵ Postea, 475.

Latent infection in yaws is often seen, especially in untreated cases of long standing. Fortunately, a low-grade infection with yaws does not carry with it the menacing dangers characteristic of syphilis. Therefore, regardless of the theoretical interpretation, the practical results of this test of reinoculation are extremely satisfactory. It seems clear that a considerable proportion of yaws cases, after treatment with neosalvarsan, will possess considerable resistance to reinfection for a long period of time. This evidence, indicating the permanency of the good results of treatment, fully justifies and encourages the efforts now being made to bring yaws under control.

SUMMARY

The following observations have been made upon the question of immunity to yaws in man:

Four yaws patients were treated with neosalvarsan and, after an interval of about six months, they were inoculated with yaws. One developed a characteristic granuloma, and the others showed atypical results. Treatment with neosalvarsan was repeated in two of these cases and in the other two the lesions soon disappeared spontaneously. After more than two years, these four patients were found to be free from any clinical signs or symptoms of yaws and the Wassermann reaction was negative. They were then reinoculated with yaws, and only one developed a typical granuloma, the same one who was susceptible in the previous test. At the time of the first course of treatment with neosalvarsan this patient had had yaws for only three months; the others had been infected for much longer periods. Therefore, three of these four patients showed well-marked resistance to reinfection with yaws. This resistance to reinfection might be explained either by the development of an active immunity or by the continuance of a latent infection with yaws. In the absence of information permitting a final decision, we have adopted as a working basis the view that active immunity develops late in the secondary stage of yaws.

It is of considerable practical significance that yaws patients, treated in the advanced secondary stage of infection, have remained in excellent health, free from any symptoms of yaws, and that they retained well-marked resistance to reinfection for more than two years. This period of time is ample to permit bringing the disease under control even in heavily infected districts.

ILLUSTRATION

PLATE 1. YAWS PATIENTS TREATED WITH NEOSALVARSAN AND SUBSEQUENTLY INOCULATED WITH YAWS

- FIG. 1. Case 1. Primary granuloma seven weeks after inoculation.
2. Case 1. The same lesion three and one-third months after inoculation.
 3. Case 4. Atypical lesion seven weeks after inoculation.
 4. Case 4. The same lesion showing spontaneous regression; three and one-third months after inoculation.



PLATE I.

SUPERINFECTION IN YAWS¹

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SIX PLATES

The many points of similarity between syphilis and yaws have been emphasized repeatedly, and at times almost to the exclusion of some of the striking differences between the two diseases. It is well established that a typical chancre cannot be produced in a patient already infected with syphilis. The following investigation was carried out to determine whether superinfection is possible in yaws.

Many observations have been recorded concerning the effects of autoinoculation or reinoculation of syphilitic patients with syphilis. The details of the facts are somewhat beclouded on account of the incompleteness of many of the experimental and clinical observations. The data are sometimes limited to a description of the clinical effects, without exact information concerning the presence of treponemata in the lesions under consideration. However, the literature on superinfection has been carefully analyzed by Neisser.² He states that, if a normal person were to be inoculated with syphilis every day, say, for one month, the first ten or fifteen inoculations would give rise to entirely typical primary chancres, but the subsequent inoculations would produce only abortive atypical reactions, or might even give entirely negative results.

¹ From the Bureau of Science, Manila.

² Arb. aus. d. kais. Gesundheitsamt 37 (1911) 155.

Only a few observations have been recorded concerning the reinoculation of yaws patients. Charlouis³ reported the production of typical granulomata following the reinoculation of patients in the active stage of yaws and of persons who had recovered spontaneously from yaws. The experiments of Charlouis were excellently conceived, but were carried out long before control by the Wassermann reaction or examination for treponemata was possible. It seems evident that his results were frequently complicated by secondary infection at the site of inoculation. That a typical attack of yaws will be produced by inoculation of a spontaneously healed patient is at variance with the evidence of clinical experience and with our own results. Jeanselme and Angier⁴ reinoculated a patient in the fourth month of the disease, and again in the fifth month, but with entirely negative results. Powell⁵ recently performed autoinoculations in eleven cases of yaws, with entirely negative results. We have already reported⁶ the results of reinoculation of patients in the tertiary stage of yaws (clavos) or in the late secondary stage, choosing patients in whom the granulomata were already disappearing spontaneously. Some abortive reactions developed but, as might have been expected, no typical granulomata were produced.

In the early stage of yaws secondary granulomata develop spontaneously and, therefore, one can naturally expect to produce superinfection artificially by experimental inoculation. Clinical histories of yaws patients are necessarily inaccurate regarding the time of onset of the disease. We have, therefore, produced yaws experimentally in a group of six volunteers in order that we might know the exact time of inoculation and the first appearance of clinical symptoms. The patients were then reinoculated at varying intervals to determine whether superinfection would produce typical granulomata showing *Treponema pertenue*. These volunteers were selected from a group of individuals who had never lived in a yaws district and in whom there was no suspicion whatever of syphilis. The Wassermann reaction was negative, except for an insig-

³ Vierteljahresschr. f. Derm. u. Syph. 8 (1881) 431.

⁴ Cited in Scheube, Die Krankheiten der warmen Länder. Gustav Fischer, Jena (1910) 228.

⁵ Proc. Roy. Soc. Méd. Sec. Trop. Dis. & Parasitol. London 16 (1922-1923) 15.

⁶ Sellards, A. W., and E. W. Goodpasture, Philip. Journ. Sci. 22 (1923) 233.

nificant trace of inhibition in one case. The general results obtained by us are given in Table 1.

The Wassermann reactions in this paper are recorded as follows:

- + , almost complete hæmolysis.
- ++ , about 50 per cent hæmolysis.
- +++ , about 75 per cent inhibition.
- ++++ , complete or almost complete inhibition of hæmolysis.

TABLE 1.—*Superinfection in yaws.*

Serial letter.	First inoculation.					
	Date of first inoculation.	Character of lesion.	Date of appearance.	Incubation period.	<i>Treponema pertenue</i> .	Wassermann reaction before inoculation..
	1925			Weeks.		
A.....	January 17..	Granuloma..	February 14..	3.5	+	—
B.....	.....do.....	.....do.....	.....do.....	3.5	+	—
C.....	.....do.....	.....do.....	February 17..	4	+	±
D.....	.....do.....	.....do.....	February 21..	4	+	+
E.....	.....do.....	.....do.....	February 17..	4	+	—
F.....	.....do.....	Atypical.....	.....do.....	.....do.....	.....do.....	—

Serial letter.	Second inoculation.						
	Date of second inoculation.	Interval between first and second inoculations.	Character of lesion.	Date of appearance.	Incubation period.	<i>Treponema pertenue</i> .	Wassermann, March 21.
		Weeks.			Weeks.		
A.....	February 14..	4	Granuloma..	March 11..	3.5	+	++
B.....	.....do.....	4	.....do.....	.....do.....	3.5	+	++
C.....	February 21..	5	.....do.....	April 4.....	6	+	+
D.....	.....do.....	5	.....do.....	March 24..	4.5	+	++
E.....	February 28..	6	.....do.....	April 4.....	5	+	++
F.....	.....do.....	6	Negative.....	.....do.....	.....do.....	.....do.....	+

Spontaneous secondary lesion.			
Serial letter.		Date of appearance.	Interval after first inoculation.
			Weeks.
A.....		March 28..	10
B.....		.....do.....	10
C.....		April 4.....	11
D.....		March 31 ..	10.5
E.....		.....do.....	10.5
F.....		May 5.....	15.5

Material for the inoculation of these cases was taken from the granuloma that developed in the first patient reported in the preceding paper.⁷ A fragment of tissue rich in treponemata was implanted in each of two incisions in the skin, made over the region of the deltoid. The incisions healed promptly, leaving a faint linear scar which showed no change until the tenth day after inoculation. At this time, both incisions in all six cases showed slight elevation of the epidermis and a slight degree of hyperæmia. Comparatively little change took place in the next few days. By the end of the third week after inoculation the lesions of the various patients began to show some minor individual variations. In case A the upper incision appeared as a ridge of epidermis, and the lesion on the lower incision, when examined with a hand lens, appeared slightly granulomatous. In four others (B, C, D, E) the lesions were definitely growing but the small zone of hyperæmia had disappeared in all but one (case C). Four days later a minute crust had begun to form in the center of the lesions of two of the cases (B and D) and in another (case E) the lesions were somewhat suspiciously granulomatous in character.

In the succeeding days the lesions rapidly took on a definitely granulomatous character; by the end of the fourth week after inoculation all of the first five patients showed a small granuloma at at least one of the two points of inoculation. By the end of the fifth week these five patients had developed definite granulomata at each of the two sites of inoculation. These increased rapidly, coalescing into one large yaw which continued to grow until treatment was commenced. In the sixth case (F) the lesions that appeared at the points of inoculation, instead of developing into granulomata, eventually regressed spontaneously.

From Table 1 it is evident that the exact time of appearance of the granulomata is stated somewhat arbitrarily. We have endeavored to note the earliest date at which the lesion would be recognized as a typical yaw by an observer entirely unfamiliar with the experimental record of these patients. Obviously the first clinical change occurred much earlier than the incubation period given for the appearance of the granulomata. No attempt was made to determine the earliest date at which treponemata could be recovered from the site of inoculation. For the study of superinfection the clinical picture is of im-

⁷ Antea, 453-461.

portance, and we did not wish to disturb the character of the lesion by the manipulation necessary in securing tissue for microscopic examination.

The Wassermann test gave either weak or moderately strong reactions about two months after the first inoculation. Its titer then increased rather rapidly. Full details are given in a later paper.⁸

REINOCULATIONS

Two of these patients (A and B) were reinoculated at the end of the fourth week after the first inoculation, two others (C and D) at the end of the fifth week, and the remaining two (E and F) at the end of the sixth week. For the first five cases autoinoculations were made, by implanting a fragment of the primary yaw in a skin incision on the same arm about 3 centimeters below the mother yaw, and also in another incision over the deltoid, together with a control incision, on the opposite arm. The sixth case, in whom no yaw developed, was inoculated with tissue from patient E.

Following reinoculation the first five patients developed clinical manifestations essentially identical with those following the first inoculation in these cases. The lesion began with a slight elevation of the epidermis accompanied by hyperæmia. In four of these five cases (A, B, C, D), this change appeared very promptly, developing within four to seven days after the reinoculation, whereas after the first inoculation an interval of ten days elapsed before any change was noted. A granulomatous lesion developed at the site of at least one of the two points of reinoculation in each of these five patients. In some, the reinoculation made near the primary yaw was "lost" by coalescence with the mother yaw. The incubation period for the development of typical granulomata, though somewhat irregular, was not strikingly different from the incubation time following the first inoculation. Table 2 shows the character and location of the typical granulomata that had developed as a result of superinfection at the time when treatment was commenced.

The two patients (A and B) who were reinoculated four weeks after the first inoculation were kept under observation for an additional period of six weeks before treatment was commenced. The lesions of these two patients are illustrated in Plates 1 and 2. In Plate 2, fig. 2, is seen a small connecting ridge of granulomatous tissue between the smaller yaw and the primary yaw.

TABLE 2.—Location and character of lesions following reinoculation of yaws patients.

Serial letter.	Reinoculation on the same arm near primary yaw.	Reinoculation on the opposite arm.
A.....	Granuloma coalescing with primary yaw.....	Small granuloma.
B.....	Typical granuloma.....	Small papule.
C.....	Small papule.....	Minute granuloma.
D.....	Granuloma coalescing with primary yaw.....	Small granuloma.
E.....	Cluster papules.....	Typical granuloma.
F.....	Negative.....	Negative.

The lower yaw developed at the site of reinoculation independently of the mother yaw. This ridge of granulomatous tissue developed by extension from the lower yaw upward to the mother yaw and made its appearance three or four days before this photograph was taken.

The illustrations of patients C, D, and E are shown in Plates 3, 4, and 5. Treatment of these cases was commenced at the end of eleven weeks after the first inoculation. The granulomata in case C developed typically but rather slowly. The reinoculation just below the primary yaw developed into a minute granulomatous lesion from which typical treponemata were demonstrated. This lesion showed no signs of regression at the time treatment was commenced. Two illustrations are given of the abortive lesions developing in patient E (Plate 6).

In the sixth patient (F) of this group the lesion behaved in an unusual manner. Following the original inoculation a slight elevation of the incisions occurred accompanied by hyperæmia, as in the other five cases. We were therefore completely surprised by the failure of these lesions to develop into typical yaws. Indeed, in this patient, ten days after inoculation, there was a distinct nodule in the middle of each of the two skin incisions corresponding to the site of implantation of the fragment of tissue, the ends of the incision showing only a barely discernible scar. Four weeks after inoculation this nodule had regressed, leaving a white area surrounded by a pink areola. Eleven days later it was noted that the pink areola around the central white area was in turn limited by a narrow white zone. The total diameter of the affected area measured 27 millimeters. From this time on, the areola of hyperæmia gradually faded, becoming white and rough. By the end of the eighth week it had disappeared without any frank desquamation. As already noted, the reinoculation in this patient gave entirely negative results.

Eleven weeks after inoculation, the Wassermann reaction in this patient gave a positive result (++) . The superficial lymphatic glands were enlarged. There was an unusual macular lesion in the palms of both hands. This will be fully described in one of the following papers, on atypical clinical lesions of yaws.⁹ A few small papules were present in the hairy part of the neck. Examination of these papules by dark field showed typical treponemata. The infection was terminated at this stage by treatment with neosalvarsan.

A generalized infection with yaws without the development of a primary lesion is of more than passing interest. Char-
louis¹⁰ inoculated thirty-two normal men with yaws, and twenty-eight became infected, a typical primary yaw appearing in each of the twenty-eight at the site of inoculation.

Nicholls¹¹ inoculated eight men successfully, but in three no primary yaw developed.

Paulet¹² reported that, of fourteen men successfully infected with yaws, only ten showed a local lesion. Powell,¹³ as the result of careful clinical observations, noted that, in contrast to the majority of clinical records, about 20 per cent of two hundred five patients showed no primary lesion. The observations of Paulet and of Nicholls are usually quoted without emphasis or comment, the tenor of the literature leaning toward the view that yaws, at least as it occurs spontaneously, is regularly initiated by the development of a primary lesion.

The case we have described differs distinctly from the observations of Powell, and apparently also from those of Paulet and of Nicholls. Instead of no reaction, a very definite, though atypical, primary lesion developed at the site of inoculation, and then spontaneous regression occurred without the formation of a granuloma. Subsequently, a typical secondary eruption appeared. The original reports of Paulet and of Powell are not available here; it is possible that these authors reported only typical granulomata developing at the site of inoculation, and omitted any mention of atypical lesions.

⁹ Postea, 475-481.

¹⁰ Vierteljahresschr. f. Derm. u. Syph. 8 (1881) 431.

¹¹ A Report on yaws in Tobago, Grenada, 1894. Cited in Brit. Med. Journ. 2 (1901) 797.

¹² Arch. Gen. Med. 17 (1848) 385. Cited in Brit. Med. Journ. 2 (1901) 797.

¹³ Proc. Roy. Soc. Med. Sec. Trop. Dis. & Parasitol. London 16 (1922-1923) 15.

SECONDARY LESIONS

The date of the appearance of secondary lesions in these cases is of interest. In the two cases (A and B) reinoculated four weeks after the first inoculation, the spontaneous secondary lesions developed distinctly later than did those appearing at the site of reinoculation. Of the two patients, reinoculated at the end of the fifth week, the secondary granulomata were noted in one (C) simultaneously with the development of the autoinoculation; in the other patient (D) the secondary lesions were not recognized as definite granulomata until one week after the autoinoculation was recorded as a typical yaw. Of the two patients reinoculated at the end of the sixth week one remained negative (F), but the other (E) showed a typical granuloma; however, this did not develop until several days after the spontaneous appearance of several secondary granulomata. This suggests that secondary dissemination of the treponemata had already taken place at the time the autoinoculation was performed.

The primary and secondary granulomata were essentially similar in character in all of these cases. In a typical example the primary yaw was sharply outlined, measuring 2 by 3 centimeters, with an elevation of 3 to 4 millimeters above the surface of the skin. It was of a reddish color and was composed of confluent efflorescences, thus giving it a lobular appearance resembling the surface of a raspberry. In some areas the surface of the lesion shows irregular superficial erosion, and in others it is covered with a dry yellowish crust. Such a granuloma bears no resemblance to the usual textbook description of the typical primary ulcer of yaws. It is indeed curious that the very significance of the word "frambœsia" has been so completely lost that the typical primary lesion is described, not as a raspberrylike growth, but as an undermined ulcer. Ulceration is not a characteristic of the primary yaw, but can be brought about through secondary infection. Hallenberger¹⁴ observed many cases of yaws in Africa and noted frequent secondary infection and ulceration of the granulomata. He proved experimentally, however, that the primary lesion is a granuloma and not an ulcer by inoculating yaws in some normal men and protecting the site of inoculation from secondary infection by a dressing. A typical granuloma developed.

¹⁴ *Beih. z. Archiv f. Schiffs- u. Tropenhyg.* (1916-1920) 5.

Some confusion exists concerning the question of adenitis in yaws. The superficial lymph glands are much enlarged. Thus, Moss and Bigelow¹⁵ noted that the epitrochlear glands were palpable in 58 per cent of eight hundred eighty-six cases of yaws in various stages. The femorals were found enlarged in 100 per cent of one hundred twenty-one cases. Clinical interpretation, however, is often complicated by the frequent occurrence of various infections in yaws patients which might explain the enlargement of the glands.

In all of the six cases that we studied, the axillary glands on the side on which the inoculation was performed became palpable during the sixth or seventh week after inoculation. Subsequently, many of the other superficial glands became either moderately or grossly enlarged in a typically indolent manner. The distribution of the affected glands is shown in Table 3.

TABLE 3.—Enlargement of lymphatic glands.

Serial letter.	Posterior auricular.		Cervical chain.		Axillary.		Inguinal.	
	Right.	Left.	Right.	Left.	Right.	Left.	Right.	Left.
A.....	+	—	—	—	+	+	—	—
B.....	—	—	—	—	+	+	—	—
C.....	+	—	—	+	+	+	+	+
D.....	+	+	—	+	+	+	+	—
E.....	—	—	+	—	+	+	+	—
F.....	+	+	—	—	+	+	—	+

In these patients there was a moderate degree of generalized lymphadenitis resulting from the systemic distribution of the treponemata, but the glands most noticeably enlarged were those draining the areas where granulomata had developed. The involvement of the lymph glands was more extensive than that ordinarily found in syphilis. The epitrochlear glands were enlarged in the patient (E) showing palmar lesions; of the other five patients, none had any lesions on the hands or forearms, and only one showed enlargement of the epitrochlear glands. Moreover, upon treatment these enlarged glands subsided very slowly. In a general way, by the time the granulomata had disappeared the enlarged glands had diminished about one-half in size.

¹⁵ Bull. Johns Hopkins Hosp. 33 (1922) 43.

The temperature of these patients was taken daily, in the afternoon, throughout the entire course of this work. No febrile reactions whatever occurred, except in one patient who developed a slight intercurrent infection which lasted only a few days.

DISCUSSION

It has not yet been possible to determine finally whether some degree of active immunity develops in yaws, or whether resistance to reinfection is due to the persistence of a low-grade infection. We have shown however that, in contrast to syphilis, superinfection in yaws is possible, even after the typical primary granuloma has developed.

Six volunteers were inoculated with yaws. Five developed a typical granuloma at the site of inoculation. On reinoculation of these five patients, a lesion developed at the site of reinoculation which, clinically, was of a granulomatous character, and treponemata were found on microscopic examination.

The sixth patient of this group showed only an abortive reaction at the site of the first inoculation, but subsequently a secondary eruption appeared.

The primary efflorescence in yaws, as in syphilis, is a papule. Whereas in syphilis the papule progresses into an irregular, sharply punched-out ulcer, in yaws it develops into an oozing granuloma which becomes covered by an amberlike crust.

ILLUSTRATIONS

PLATE 1. PATIENT A

- FIG. 1. Two primary granulomata, four weeks after inoculation.
2. The same as fig. 1, six weeks later, including an area of superinfection at the lower pole, coalescing with the primary lesion, ten weeks after the first inoculation.
 3. Superinfection on the opposite arm, six weeks after a reinoculation performed four weeks after the first inoculation.

PLATE 2. CASE B

- FIG. 1. Two primary lesions, four weeks after inoculation. The granulomatous character of these lesions was unmistakable, but this is not clearly shown in the illustration.
2. The same as fig. 1, six weeks later, showing coalescence into one large granuloma (ten weeks after the first inoculation). Below this is a smaller granuloma produced by reinoculation performed four weeks after the first inoculation.

PLATE 3. CASE C

- FIG. 1. Two primary granulomata, four weeks after inoculation.
2. The same as fig. 1, one week later, at the time of reinoculation.
 3. The same as fig. 1, six weeks later, showing coalescence into one large granuloma (eleven weeks after the first inoculation). Just below this is one minute granulomatous lesion developing at the site of a reinoculation performed five weeks after the first inoculation.
 4. Spontaneous secondary yaw in the right axilla at the end of eleven weeks after the first inoculation.

PLATE 4. CASE D

- FIG. 1. Two primary granulomata, four weeks after inoculation.
2. The same as fig. 1, one week later, at the time of reinoculation.
 3. The same as fig. 1, six weeks later (eleven weeks after the first inoculation).
 4. Superinfection on opposite arm, six weeks after reinoculation performed five weeks after the first inoculation.
- FIGS. 5 and 6. Spontaneous secondary granulomata, eleven weeks after the first inoculation.

PLATE 5. CASE E

- FIG. 1. Two primary granulomata, four weeks after inoculation.
2. The same as fig. 1, two weeks later, at the time of reinoculation.
 3. The same as fig. 1, five weeks later (eleven weeks after the first inoculation).

- FIG. 4. Superinfection on the opposite arm, five weeks after reinoculation performed six weeks after the first inoculation.
5. Spontaneous granuloma, eleven weeks after the first inoculation.

PLATE 6. CASE E.

- FIG. 1. Two primary lesions, four weeks after inoculation.
2. The same as fig. 1, two weeks later, shortly before spontaneous regression. These lesions are rough, but not elevated.

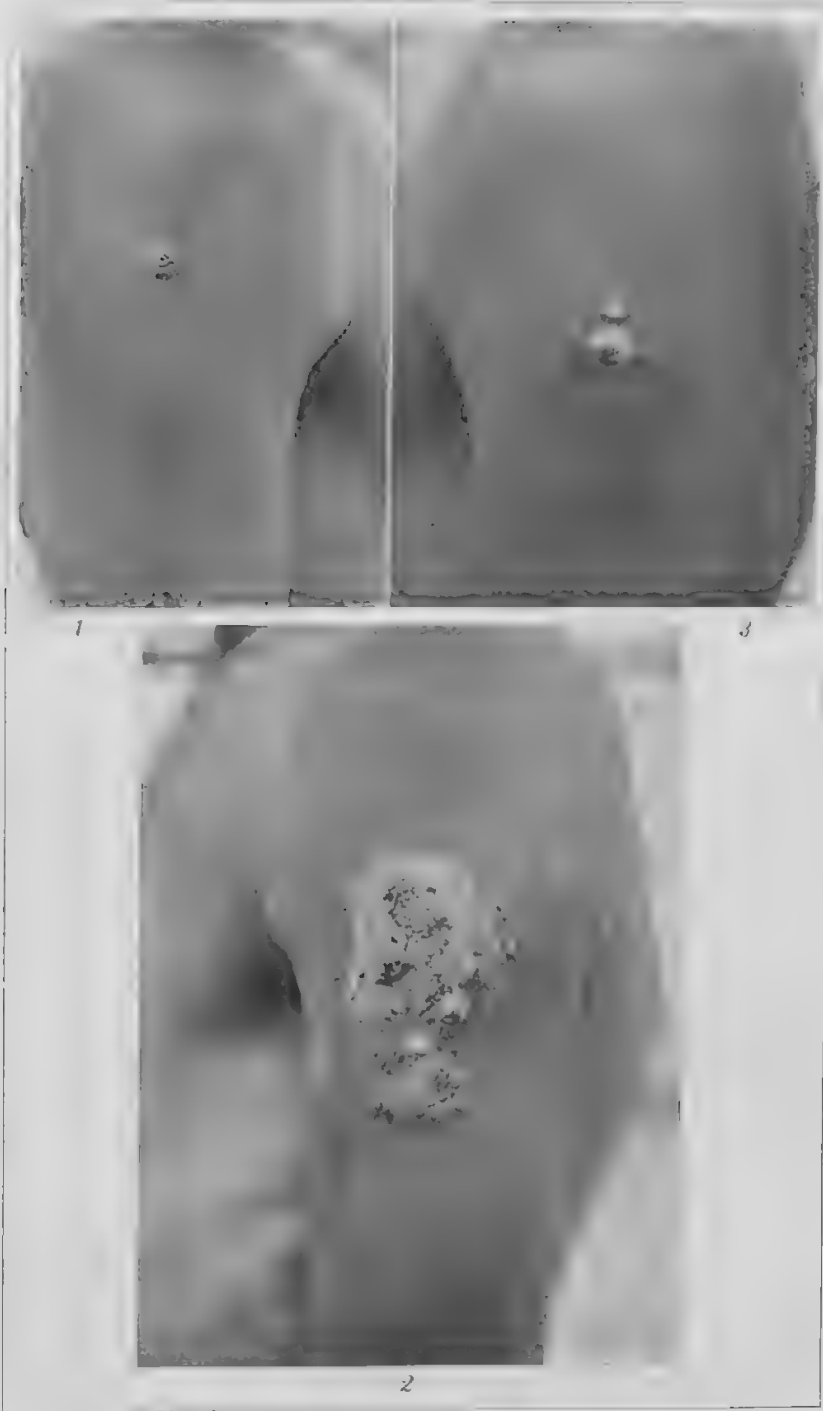
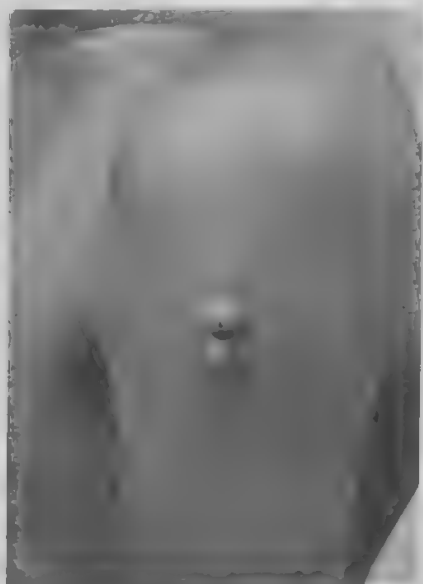


PLATE I



1



2

PLATE 2.

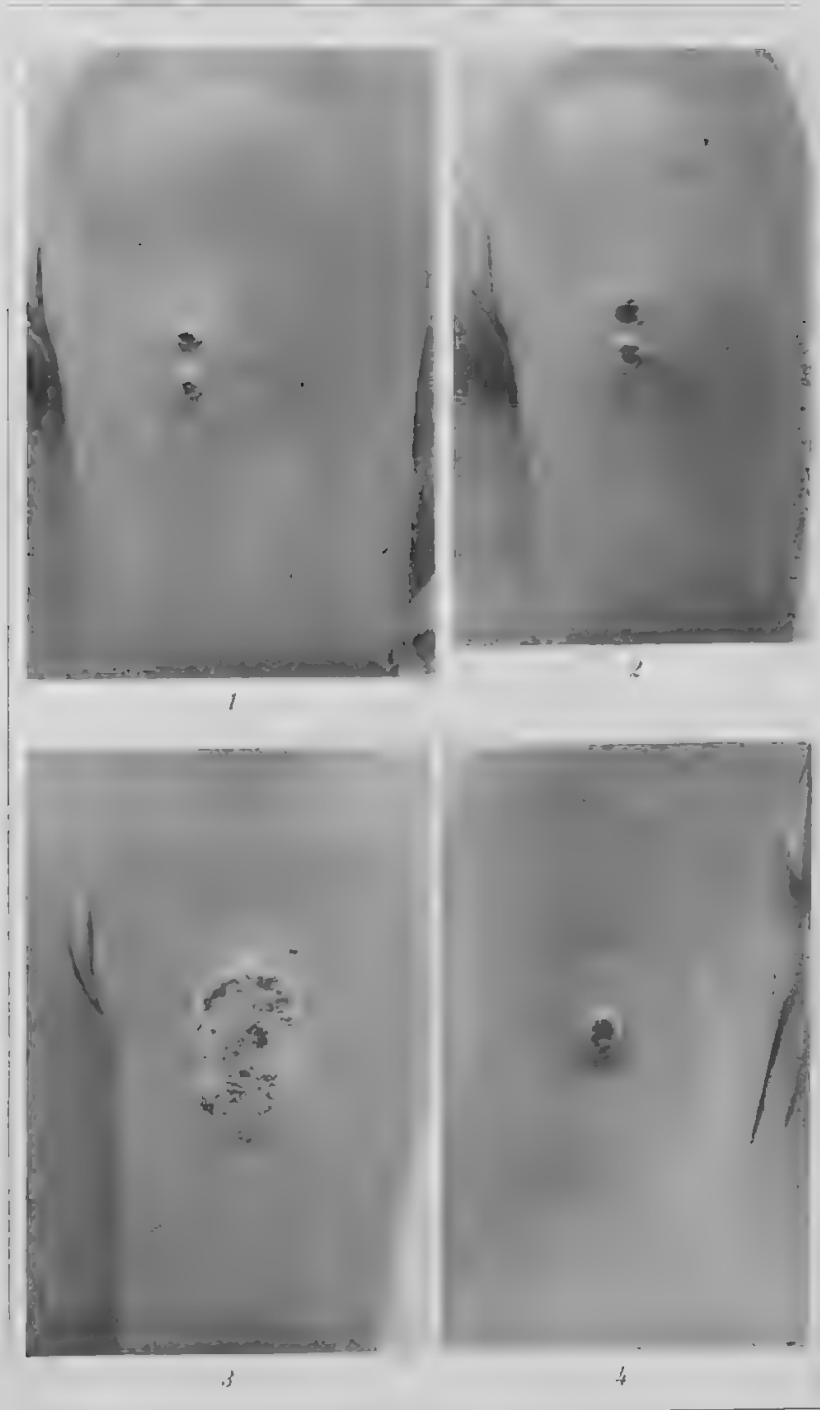


PLATE 3.



PLATE 4.

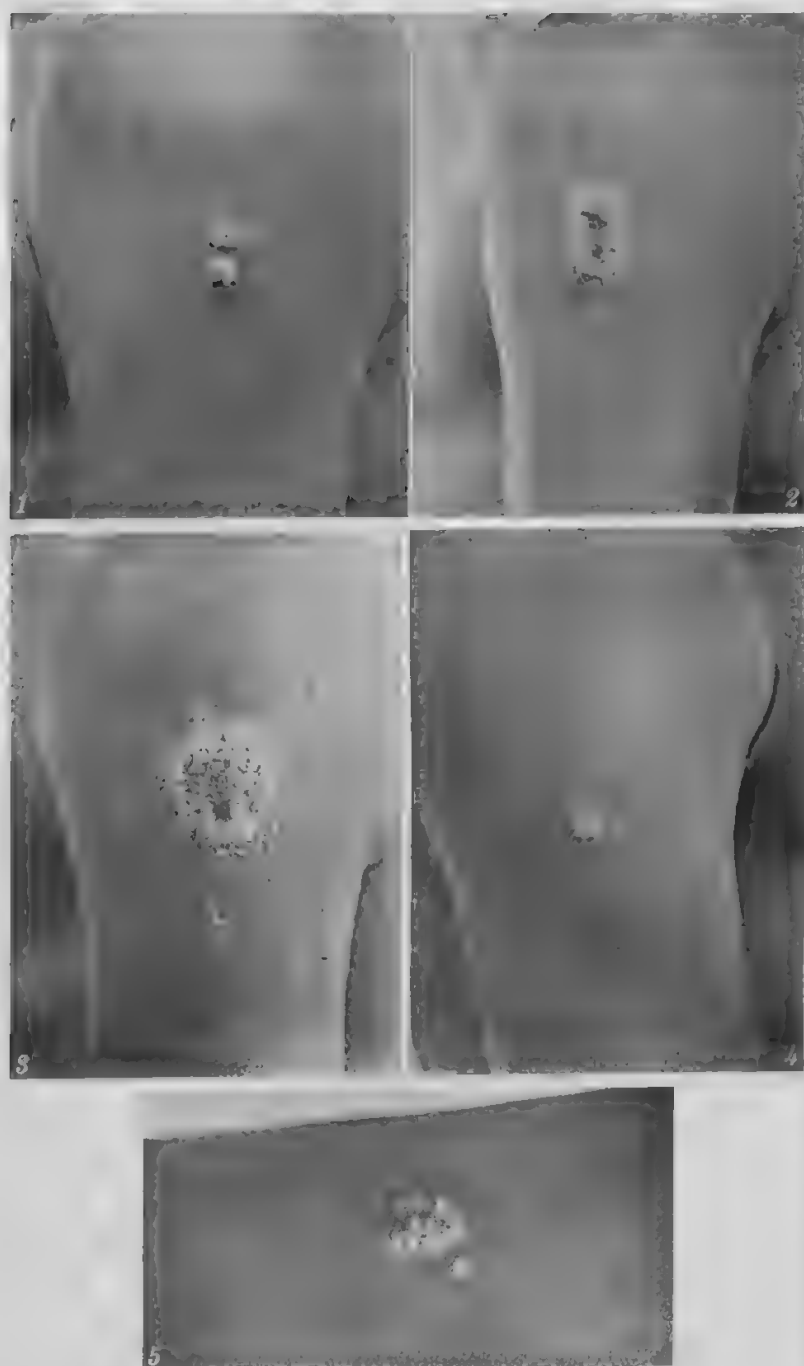


PLATE 5.



PLATE 6.

SOME PROTEAN MANIFESTATIONS OF THE SKIN LESIONS OF YAWS¹

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THREE PLATES

When comparison is made between syphilis and yaws it is customary to emphasize the protean nature of the clinical manifestations of syphilis and the almost monotonous uniformity of the lesions of yaws. During the course of the work on the inoculation of yaws in man² some unusual clinical features were observed. Under the conditions of experimental control it was possible to determine definitely that these lesions were due to yaws, though under ordinary conditions the interpretation of some of them would have been difficult or impossible. In the following descriptions it will be necessary to refer to some of the cases and illustrations discussed in the preceding papers on immunity and on superinfection.³

Three types of atypical lesions were observed; namely, a lichenoid eruption surrounding the point of inoculation or reinoculation; a circular exfoliative maculo-squamous exanthem on the palms; and a keratoid exanthem of the trunk and extremities.

The most striking illustration of the first type of lesion was observed in patient 4, a treated case of yaws who was inoculated again with yaws two years after his last treatment. The illustration (Plate 1, fig. 3)³ shows the lesion at the height

¹ From the Bureau of Science, Manila.

² *Antea*, 463-474.

³ The cases and illustrations discussed in the following six paragraphs are reported in *antea*, 453-461, and 463-474.

of its development. As previously noted, the small oval area of normal skin can be observed, the center of which represents the point of reinoculation. This normal area is surrounded by multiple efflorescences; these are discrete, but show a tendency to concentric grouping toward the center, while on the periphery they radiate into the normal skin. The individual efflorescences are acuminate papules with a narrow base and a silvery white glistening summit. The coalescence of the efflorescences produces clusters with more-extensive, scalelike surface. There is no exfoliation of the scaly glistening surface of the efflorescence. The scale can be removed easily and its base does not bleed, as in psoriasis. The efflorescences are distinctly of lichenoid character in as much as, from the beginning to the end, they persist as papules, but the scaling of the summit is more pronounced than in lichen planus and the summit is only slightly flattened and not umbilicated. By coalescence, clusters of considerable size are produced, but the individual efflorescences are distinctly discernible in the clusters and do not coalesce into large confluent patches. This lesion disappeared spontaneously without leaving any area of pigmentation—a feature which occurs commonly after the healing of an ordinary granuloma.

A less-striking example of this lesion occurred under similar circumstances; namely, in patient 3, a treated case of yaws, who was reinoculated three years after treatment.

Another treated patient (No. 1) upon reinoculation developed a typical granuloma which, however, grew slowly and later was surrounded by white efflorescences similar to those just described (Plate 1, fig. 2).³ At first glance we saw nothing in this lesion in any way suggestive of yaws. Yet, by mere exclusion, it seemed necessary to accept the interpretation that this lesion was in some unexplained way the result of the reinoculation.

Subsequently, something of a connecting link was observed between these skin lesions and others of a somewhat similar nature which occurred in two of the normal persons inoculated with yaws. One of these is the patient F (Plate 6, fig. 2)³ who failed to develop a primary yaw. In the other, D (Plate 4, fig. 3),³ a typical granuloma appeared at the site of inoculation. This was seen surrounded by several small red papules which enlarged and coalesced with the mother yaw. Then additional papules appeared which soon became dry and white.

Three of the patients (3, 4, and F) in whom these lesions occurred failed entirely to develop granulomata at the site of inoculation with *Treponema pertenue*; in two others (A and 1),

efflorescences developed around primary granulomata that had reached their maximum limit of development. It is possible that these lesions may be associated in some measure with an increase in the patient's resistance to infection.

The lesions of the palms (Plates 1 and 2) appeared almost simultaneously with the secondary eruption of yaws. They were restricted to the palms and to the flexor surface of the fingers and the wrist. They were multiple and somewhat symmetric, measuring from 0.5 to 2 centimeters in diameter. They appeared in rapidly successive crops. The primary efflorescence was a flat macule of copper color on the almost white skin of the palm in a half-caste. The larger macules showed a central circular exfoliation. The margin of the exfoliated area was formed by a paper-white undermined epidermis. The base of the exfoliated area was dry, reddish, and slightly indurated, and showed moderate secondary exfoliation. The exfoliation progressed proportionately to the spread of the original macule. Consequently, the largest lesions presented chiefly exfoliated areas outlined by a dark red, slightly raised margin, representing the remains of the original macule. Treatment with neosalvarsan caused prompt disappearance of these lesions.

Of all the skin diseases restricted to the palm, the only one that deserves serious consideration, from the standpoint of differential diagnosis, is syphiloderma manus. The dermatologic picture of the lesions in the palms of this case of yaws remarkably resembles that described and illustrated as syphiloderma manus by Fox.¹ Only by virtue of the experimental conditions, which excluded hereditary and acquired syphilis beyond doubt, were we in a position to decide definitely that the lesions on the palms of this case were of framboesial origin.

At a later date, with Dr. Lopez-Rizal, we examined thirty-three cases of yaws in Mountain Province,² in a district where syphilis is so rare that its presence has not yet been definitely established. Two of these cases showed palmar lesions very similar to those in this experimental case.

It would be interesting to observe the course of this palmar framboeside without treatment. It can hardly be the usual forerunner of the classical case of "clavos." We have seen the various stages in the development of clavos, beginning with typical multiple granulomata in the palms of the hands or the

¹ Photographic Atlas of the Diseases of the Skin. J. B. Lippincott Co., Philadelphia and London (1904).

² Postea, 497-505.

soles of the feet. Subsequently the surrounding epidermis becomes greatly thickened and exfoliates, while the original granulomata dry up, leaving a hard center like a nail, and this eventually falls out, leaving a "nail-hole." Thus in Spanish-speaking countries the condition received the name of "clavos." On the other hand, cases of clavos are extremely common, in which only greatly thickened layers of exfoliating epidermis are seen with no trace whatever of the original granulomata. It is quite conceivable that some of these cases may have originated merely as a frambœside without any development of granulomata.

A beautiful illustration occurred in one patient (No. 1) ⁶ of what may be called keratoid exanthem of the trunk and extremities. This patient, it will be recalled, had been reinoculated more than two years after his last treatment for yaws. A primary yaw developed promptly and, six months later, secondary granulomata appeared on the scalp. The rest of the body was almost free from granulomata, but over the back and on the chest and the extremities there was an abundant exanthem (Plate 3). The eruption was sparse over the abdomen and on the arms and legs; it was most marked over the extensor surfaces. The lesions were circinate, varying in diameter from 1 to 3 centimeters, and they were slightly hyperæmic at the margin. They were rough on palpation and were rendered prominent to the eye by the very distinct, white papillæ that stood erect like goose flesh. This effect became more pronounced when a physiological goose flesh was induced by exposure of the patient's body to a cool breeze. The individual efflorescences of which such macular lesions are composed remind one of keratosis pilaris. As in keratosis pilaris, they are numerous and are small, conical, follicular papules of white color located over the trunk and the extensor surfaces of the extremities. In the case under discussion there was no itching, but the depigmentation of the entire area, which involved the hair of the skin, was much more pronounced than in keratosis pilaris. There was no desquamation and the lesions were not diffuse, but were arranged in multiple, distinct, sharply outlined patches.

According to Schüffner,⁷ macular depigmented exanthems are not infrequent among the natives of Sumatra. Schüffner con-

⁶ Antea, 456.

⁷ Münchener Med. Wochenschr. 54² (July-December, 1907) 1366.

siders them pathognomonic for yaws and remarks that these exanthems are well known as manifestation of yaws to the natives of Sumatra, who call them *bunga puru* (the blossoms of yaws). Schüffner further states that, with the possible exception of Fournier's "syphilide papuleuse ponctuée," no such exanthem exists in syphilis.

Baermann⁸ describes and illustrates a similar condition as a chronic, rather rare, pathologic lesion of the skin. The similarity of the general character of this lesion to other atypical lesions leads him to believe that there is no doubt as to the etiology of the exanthem, although he was unable to demonstrate *Treponema* in these lesions. Baermann's clinical observation is confirmed by our experimental evidence.

Gutierrez,⁹ under the heading of "macular lesions," describes skin manifestations in yaws similar to the palmar maculo-squamous changes and the keratoid efflorescences that we noted. He believes these lesions to be framboesial, but says: "Those who have studied the disease do not always accede the occurrence of this type of eruption." This statement clearly indicates a disagreement among frambæologists as to the etiologic classification of these cutaneous manifestations. Consequent to our observation there is no longer doubt that these lesions are framboesides, or that the exanthems described by Schüffner, by Baermann, and by Gutierrez belong to the same group of independent secondary framboesides and are identical with the one observed by us.

Under treatment with neosalvarsan the granulomata disappeared promptly in our patient, but traces of the exanthem were still present three weeks after the second injection of neosalvarsan. This slow disappearance is not surprising when we remember that the exanthem was characterized by loss of pigment—a character common to all framboesides accompanied by loss of pigment.

DISCUSSION

One of the striking features of *Treponema pallidum* is the great variety of clinical manifestations that it produces. In striking contrast, *Treponema pertenue* is usually considered as producing remarkably uniform lesions, having lost or else never having acquired such versatility.

⁸ Beihefte z. Arch. f. Schiffs- u. Tropenhyg. 15 (1911) 5.

⁹ Arch. Dermat. & Syph. 6 (1922) figs. 13 and 14.

In this paper, however, we have emphasized that in the skin manifestations of yaws there are, in addition to the typical granuloma, at least three other types of exanthem, distinct in themselves rather than representing different stages of one and the same lesion. The skin manifestations of *T. pertenue* are almost as varied as are those produced by *T. pallidum*.

All of the three atypical lesions herein described were observed in experimental cases whereby their etiology was definitely determined.

ILLUSTRATIONS

PLATE 1

Palmar framboeside occurring in patient F.

PLATE 2

Palmar framboeside occurring in patient F.

PLATE 3

Keratoid exanthem occurring in case 1.

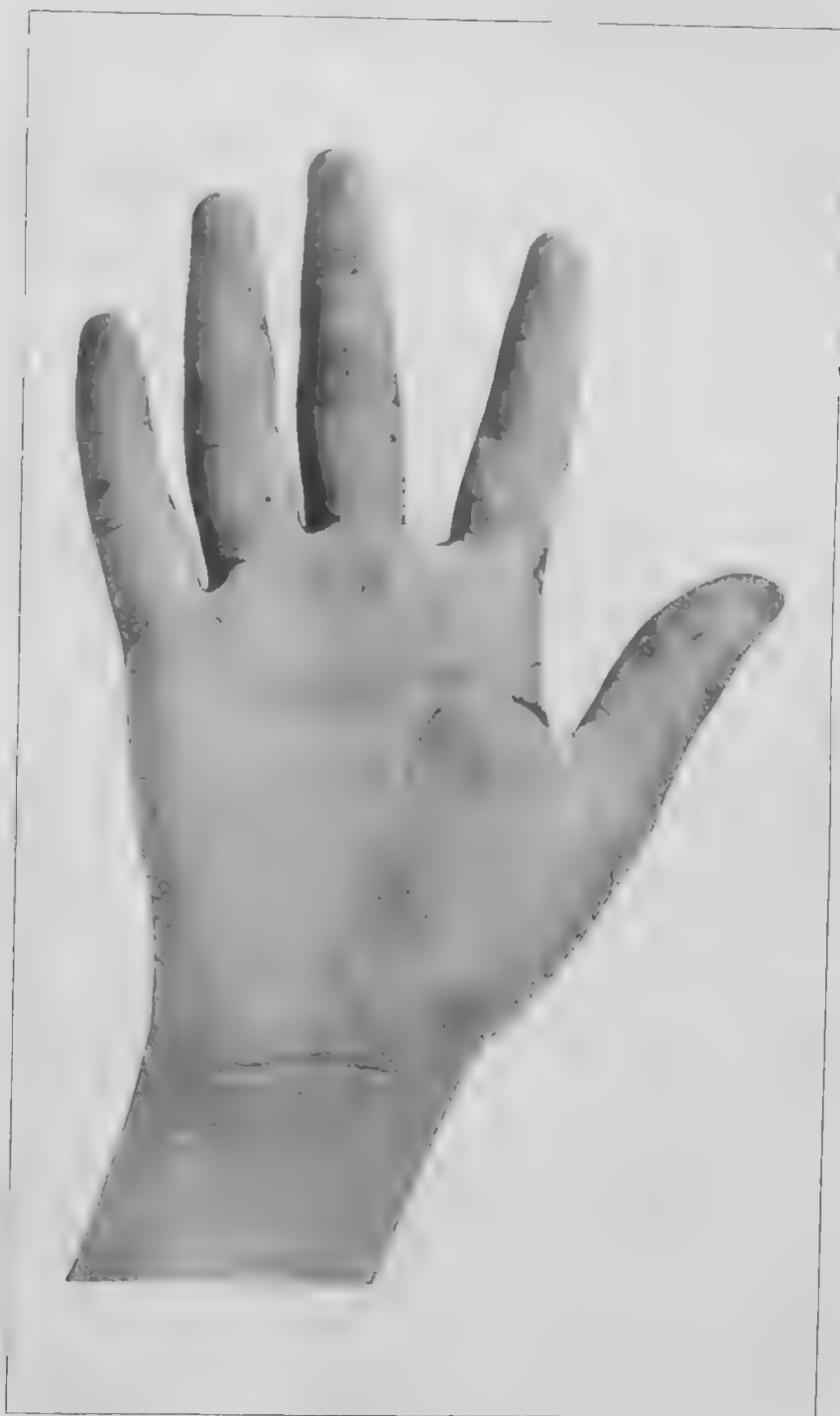


PLATE I.

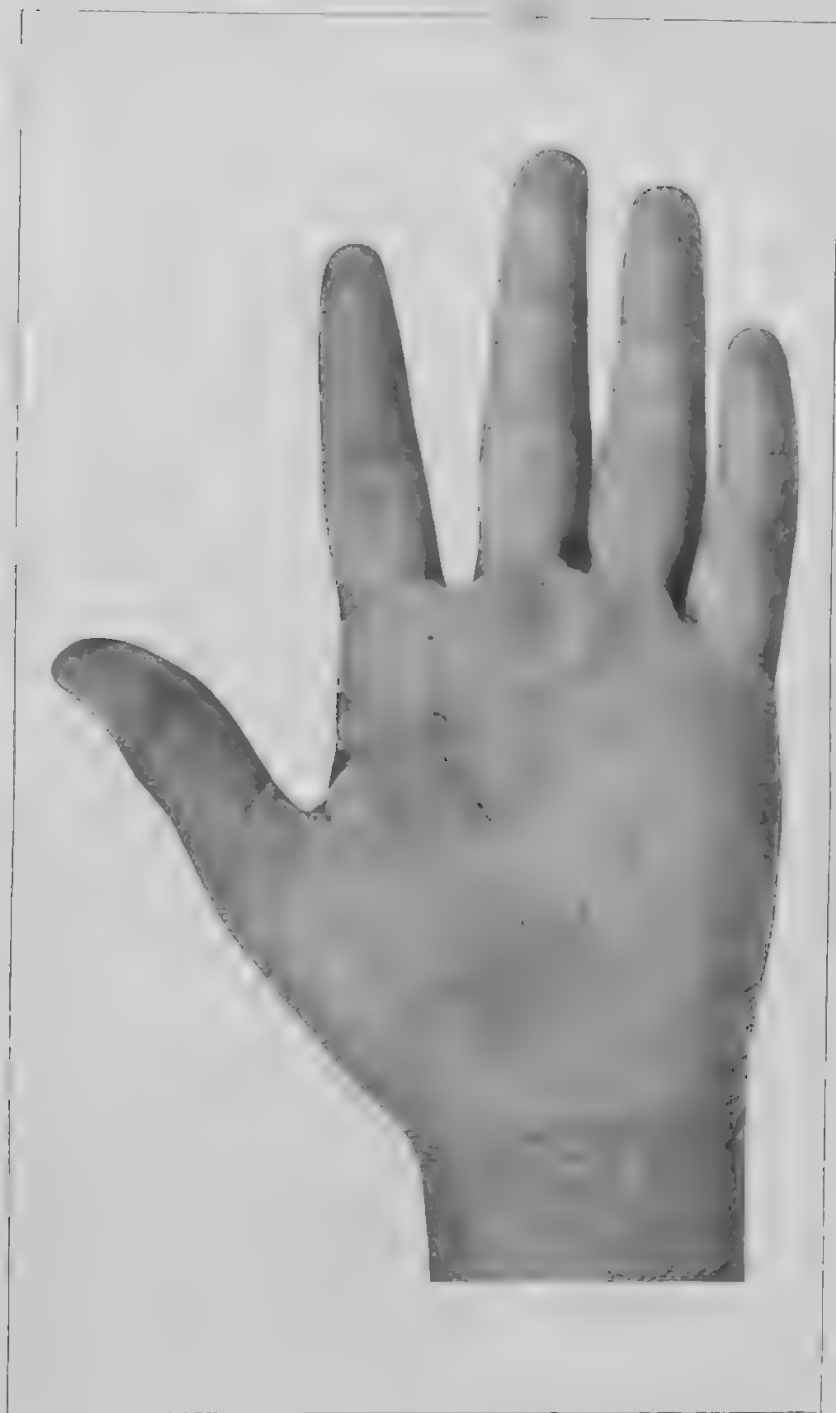


PLATE 2.



PLATE 3.

THE GLOBULIN PRECIPITATION REACTION IN YAWS

ITS INDEPENDENCE OF THE WASSERMANN REACTION AND ITS BEHAVIOR DURING THE COURSE AND TREATMENT OF THE DISEASE

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INTRODUCTION

The findings resulting from the application of the globulin precipitation test to the sera of lepers have been reported in a previous paper.¹ In brief, this test depends on the precipitation of globulin in a patient's serum upon dilution with distilled water. The principle involved in this reaction is the same as that involved in the reaction of Klausner,² but the factor of low temperature and the quantitative estimation of the serum have been introduced by us.

Simultaneously with the globulin precipitation test, the Wassermann test was carried out. It was found that in all forms of leprosy (macular, tubercular, neural, or mixed), treated or untreated, the globulin precipitation reaction was positive in all cases tested. While the degree of this reaction varied in individual cases, there was found an indication that among the treated lepers, the arrested cases (that is to say, microscopically and clinically negative) usually gave less-pronounced reaction than did the active cases, treated or untreated. Perfectly healthy normal individuals, of the same race, showed negative results up to the dilution with distilled water of their sera in the proportion of one part of serum to three parts of distilled water. In higher dilutions than 1:3, the sera gave positive results in certain cases of healthy persons. Therefore, the dilution 1:3 was taken as the normal limit, in as much as none of the sera of healthy persons tested gave any precipitation at that dilution. On the part of the cured lepers the reaction of globulin precipitation approached this normal limit to a certain extent, although all of them showed more or less pronounced precipitation in the 1:3 dilution. It became further

¹ Schöbl, Otto, and M. Basaca, *Philip. Journ. Sci.* 25 (1924) 1-9.

² *Wiener Klin. Wochenschr.* 21 (1908) 214, 363, and 940.

evident that there was no relation between the results of this test and those of the Wassermann test, performed with the same lepers' sera. This observation led us to believe that no relation exists between globulin precipitation and the Wassermann test in leprosy. It remained, however, to show further that this independence of the two reactions is true generally and not only in leprosy and, if possible, to demonstrate experimentally that the protein substance precipitable by dilution of serum with distilled water is different from that which carries the Wassermann antibody.

In the paper cited above¹ there were included in the test a few sera obtained from patients suffering with beriberi, yaws, syphilis, or afebrile tuberculosis. Of these various diseases, the precipitation was most pronounced with the serum from a patient who had suffered from active yaws, in whom the clinical manifestations had disappeared under treatment with neosalvarsan. Indeed, the reaction was more pronounced than any that had occurred in the previous examinations. This result led us to undertake a further investigation in respect to yaws, and it was hoped that parallel tests by the globulin precipitation and the Wassermann reactions would give further information as to whether the globulin precipitation and the Wassermann tests are dependent upon the presence of the same substance in the serum or whether they are independent of each other. The Wassermann reaction, as is well known, is strongly pronounced in cases of yaws, particularly active ones. The result obtained with one patient's serum by globulin precipitation reaction suggested that this reaction may be also generally positive in yaws.

As mentioned in the paper by Schöbl and Basaca,² the globulin precipitation test must be considered as a nonspecific reaction. Nevertheless, even though the reaction be evidently positive in several diseases, its value as an adjuvant method need not be underestimated. We may consider the investigation of a patient's serum, by various serological methods, as a general serological analysis, analogous to the general urine analysis. If we carry the comparison through, we should place this and other nonspecific serologic reactions in the same group of tests with the examination of the urine for albumin. The presence of albumin in the urine in itself does not necessarily indicate

¹ Philip. Journ. Sci. 25 (1924) 1-9.

nephritis or any other particular disease resulting in albuminuria; yet no one will deny the value of this test for albumin in a given case. Neither does a positive Wassermann reaction necessarily indicate that the patient suffers from syphilis.

THE GLOBULIN PRECIPITATION REACTION IN YAWS AND ITS INDEPENDENCE OF THE WASSERMANN REACTION

In the course of our investigation we had the opportunity to test the sera of a series of active cases of yaws and also of a group of yaws patients treated three years previous to our investigation.⁴

As to the technic, we wish to emphasize that the blood was taken by means of a sterile syringe, and placed in sterile test tubes. After clotting, the serum was centrifuged free of cells and examined by the globulin precipitation test within five hours after the blood had been obtained. The technic described by Schöbl and Basaca⁵ was strictly followed and the readings refer to actual precipitation encountered in the tubes that contained the stirred dilutions of serum and distilled water, were allowed to stand for two hours at room temperature (about 28° C.), and then kept overnight in the refrigerator (at between 6° and 9° C.). As far as the technic of the Wassermann reaction is concerned⁶ the reagents and their amounts are evident from the tables.

A positive globulin precipitation test was found in each of twenty-four successive cases of active yaws. The Wassermann reaction is also constantly positive in secondary yaws. Therefore, patients after treatment offer greater possibility of variation for comparison of these two reactions. We therefore tested the serum of sixteen cases after treatment. From Tables 1, 2, and 3 we can see the disagreement, both qualitative and quantitative, between the globulin precipitation and the Wassermann reactions. Although some of the low-grade reactions as well as the high-grade reactions agree, there is a sufficient number of them that disagree. This appears to be further evidence of the independence in general of the two reactions, as already found in leprosy.⁷

⁴ Sellards, A. W., et al., *Philip. Journ. Sci.* 22 (1923) 219-285.

⁵ *Philip. Journ. Sci.* 25 (1924) 1-9.

⁶ Schöbl, Otto, and Carlos Monserrat, *Philip. Journ. Sci.* § B 12 (1917) 249.

⁷ Schöbl, Otto, and M. Basaca, *Philip. Journ. Sci.* 25 (1924) 1-9.

EXPLANATION OF SYMBOLS USED IN TABLES

Globulin precipitation test:

- , no precipitate.
- ±, faint precipitate.
- +, distinct precipitate.

Wassermann reaction:

- , negative.
- +, weakly positive.
- ++, moderately positive.
- +++, strongly positive.

TABLE 5

Ratios at the head of the table indicate dilutions of equal amounts of patient's serum and increasing amounts of distilled water.

Fractions heading the Wassermann reaction columns indicate dilutions of complement.

Alc. ant., alcoholic antigen.

Chol. ant., cholesterinized alcoholic antigen.

Ser. con., serum control.

Dates at the head of the table indicate the days when blood was withdrawn from the patients.

Treatment once weekly was given to patients A and B, April 1 to April 22; to patients C, D, and E, April 7 to April 29; and to patient F, May 5 to May 12.

Lymphadenitis:

- , no glands palpable.
- ++, bilateral brachial or epitrochlear.
- ++++, multiple lymphadenitis.
- 0, not examined.

TABLE 1.—Showing the results of the globulin precipitation reaction in active cases of yaws.

No.	Name.	Age.	Dilution of serum with H ₂ O—				
			1:1	1:2	1:3	1:4	1:5
		Yrs.					
1.	S. B.	9	—	—	+	+	+
2.	B. H.	8	—	—	+	+	+
3.	R. S.	10	—	+	+	+	+
4.	E. A.	8	+	+	+	+	+
5.	B. G.	10	—	+	+	+	+
6.	E. L.	50	—	—	+	+	+
7.	P. P.	6	—	+	+	+	+
8.	N. Y.	30	—	—	+	+	+

TABLE 2.—Showing the results of the globulin test and the Wassermann reaction in active cases of yaws.

No.	Name.	Age.	Globulin test, dilution of serum with H ₂ O—					Wassermann reaction.				Remarks
			1:1	1:2	1:3	1:4	1:5	Alc. ant.		Chol. ant.		
								1/10	1/5	1/10	1/5	
		Yrs.										
9	E. P.	45	±	+	+	+	+	+	—	+	—	
10	A. G.	15	±	+	+	+	+	±	—	+	—	
11	C. E.	52	—	—	+	+	+	+	—	+++	—	
12	A. L.	13	—	+	+	+	+	±	—	+++	—	
13	I. S.	7	—	+	+	+	+	+	—	++	—	
14	P. L.	39	—	—	+	+	+	—	—	—	—	
15	Procta, L..	10	—	+	+	+	+	±	—	++	—	
16	E. G.	6	—	+	+	+	+	+	—	+	—	
17	M. M.	16	—	—	+	+	+	—	—	—	—	Suspected yaws.
18	B. C.	16	—	—	+	+	+	+	—	+++	—	
19	T. de la C..	14	—	±	+	+	+	+	—	+	—	
20	F. G.	11	—	+	+	+	+	++	—	++	—	
21	E. P.	70	—	—	+	+	+	+	—	++	—	
22	A. I.	12	±	+	+	+	+	+++	++	+++	++	See Table 4.
23	F. V.	13	—	+	+	+	+	++	—	+++	+	Do.
24	J. M.	8	—	+	+	+	+	+	—	++	—	Do.

To add experimental evidence to this observation we arranged the following experiment, the result of which is evident from Table 4.

Blood was collected from three active yaws patients—Antonio Iloya, 12 years; Fernando Vasquez, 13 years; and Julio Malopa, 8 years old.

Within five hours after the collection of the blood the globulin precipitation reaction was performed and the result read next morning. A distinct precipitate was noticed in 1:1 dilution of serum with distilled water and in all following dilutions in the case of Antonio Iloya, and distinct precipitate was found in all dilutions of the serum beginning with 1:2 in the case of F. Vasquez and of J. Malopa. The dilution 1:3 in the case of A. I. and of F. V., and the dilution 1:2 in the case of J. M., were centrifugated and the precipitate packed at the bottom of the test tube. The clear supernatant fluid was carefully decanted and used for Wassermann reaction.

TABLE 3.—Showing the results of the globulin test and the Wassermann reaction in treated cases of yaws.

No.	Name.	Age.	Globulin test, dilution of serum with H ₂ O—					Wassermann reaction.				Remarks.
			1:1	1:2	1:3	1:4	1:5	Alc. ant.		Chol. ant.		
								1/10	1/5	1/10	1/5	
		1rs.										
1	L. M.	12	—	—	—	±	+	—	—	—	—	(a)
2	F. P.	10	—	—	±	+	+	+	—	++	—	
3	F. M.	9	—	±	+	+	+	—	—	+	—	
4	L. R.	8	—	+	+	+	+	—	—	—	—	
5	C. S.	12	—	+	+	+	+	—	—	+	—	
6	G. S.	11	±	+	+	+	+	—	—	++	—	
7	E. G.	14	—	—	+	+	+	—	—	—	—	
8	D. de la I.	7	—	—	+	+	+	—	—	—	—	
9	J. B.	9	—	—	+	+	+	—	—	+	—	
10	P. de L.	7	—	±	+	+	+	+	—	++	—	
11	C. R.	9	—	+	+	+	+	—	—	—	—	
12	P. G.	13	—	—	+	+	+	±	—	+	—	
13	A. F.	8	—	—	±	+	+	—	—	—	—	
14	L. E.	9	—	—	+	+	+	+	—	+	—	
15	B. F.	12	—	—	±	+	+	±	—	±	—	
16	L. L.	9	—	—	+	+	+	+	—	++	±	
17	R. de L.	8	—	—	±	+	+	±	—	+	—	
18	C. F.	8	—	—	±	+	+	±	—	+	—	
19	V. C.	8	—	—	+	+	+	++	—	++	±	

* Complete serologic cura.

TABLE 4.—Showing the result of the Wassermann reaction with sera of yaws patients before and after the removal from the sera of the protein which precipitates on dilution with distilled water. Cholesterinized antigen and two units of amboceptor were used.^a

No.	Name.	Precipitated serum.		Unheated serum.		Heated serum.	
		1:10 ^b	1:5 ^b	1:10 ^b	1:5 ^b	1:10 ^b	1:5 ^b
22	A. I.	+++	++	+++	+++	+++	+++
23	F. V.	+++	+	+++	+	+++	+
24	J. M.	++	—	++	—	++	—

^a See Table 2 for results of globulin precipitation test.^b Dilution of complement.

The Wassermann reaction was carried out in the following way: As soon as the patients' sera had separated they were decanted and centrifuged clear of red cells. Part of each serum was used for the globulin test and the remainder of the sera was stored in the refrigerator. Immediately before the Wassermann test was performed (that is to say, the morning after the day on which the blood was collected), half of each serum was

inactivated by heating at 56° C. for thirty minutes on the water bath; the other half of each serum was used without heating. In this way three samples of each patient's serum were examined simultaneously: Patients' unheated serum diluted with water and allowed to precipitate as described above; patients' unheated serum diluted correspondingly with distilled water immediately before the Wassermann test; and patients' inactivated serum treated in the same way diluted correspondingly with distilled water immediately before the Wassermann test was performed. Two units of amboceptor 1:10 and 1:5 dilution of complement were used. Further details of the experiment are evident from the table. All three of the sera gave positive results; one was very strong, one was moderately so, and one was weakly positive.

It has been clearly demonstrated by this experiment that there is no relation between the precipitable protein substance (that is, the substance that precipitates from the serum upon dilution with distilled water) and the substance that carries the Wassermann antibody. The result of the Wassermann reaction, both qualitatively and quantitatively, was the same with the sera, whether examined fresh, or heated for thirty minutes at 56° C., or whether supernatant fluid only was used for the Wassermann reaction. In other words, whether the globulin precipitated out of the serum by dilution with distilled water was removed from or retained in the patients' sera, the result of the Wassermann reaction was exactly the same.

THE GLOBULIN PRECIPITATION REACTION IN YAWS AND ITS BEHAVIOR DURING THE COURSE AND TREATMENT OF THE DISEASE AS COMPARED WITH THE WASSERMANN REACTION

The globulin precipitation reaction in yaws varies in degree in active as well as in healed cases. As an anamnestic reaction it appears to last longer than the Wassermann reaction, in which respect yaws resembles leprosy. The considerable differences in the strength of the globulin reaction, as encountered among individuals with active and healed yaws, cannot be explained unless the starting stage and the progress of the reaction are known in the course of the disease. In six patients (A, B, C, D, E, and F)^a the globulin and the Wassermann reactions were tested at frequent intervals during the incubation period, at the height of the clinical symptoms, and after treatment with neosalvarsan. The results of the successive examina-

^a Antea, 464 et seq.

tions by the globulin and the Wassermann reactions are given in Table 5.

TABLE 5.—Showing the progress of globulin precipitation and the Wassermann reaction in yaws during the course and treatment of the disease.

Name.*	January 17.									
	Globulin precipitation reaction.					Wassermann reaction.				
	1:1	1:2	1:3	1:4	1:5	Alc. ant.		Ser. con.	Chol. ant.	
						1/5	1/10		1/5	1/10
A.....	—	—	±	+	+	—	—	—	—	—
B.....	—	—	±	+	+	—	—	—	—	—
C.....	—	—	—	+	+	—	—	—	—	±
D.....	—	—	±	+	+	—	—	—	—	—
E.....	—	—	—	+	+	—	—	—	—	—
F.....	±	—	±	+	+	—	—	—	—	—
Name.*	February 14.									
	Globulin precipitation reaction.					Wassermann reaction.				
	1:1	1:2	1:3	1:4	1:5	Alc. ant.		Ser. con.	Chol. ant.	
						1/5	1/10		1/5	1/10
A.....	—	±	+	+	+	—	—	—	—	—
B.....	—	+	+	+	+	—	—	—	—	—
C.....	—	±	+	+	+	—	—	—	—	±
D.....	—	+	+	+	+	—	—	—	—	—
E.....	—	±	+	+	+	—	—	—	—	—
F.....	—	±	+	+	+	—	—	—	—	—
Name.*	March 6.									
	Globulin precipitation reaction.					Wassermann reaction.				
	1:1	1:2	1:3	1:4	1:5	Alc. ant.		Ser. con.	Chol. ant.	
						1/5	1/10		1/5	1/10
A.....	—	—	+	+	+	—	+	—	—	+
B.....	—	±	+	+	+	—	±	—	—	++
C.....	—	—	+	+	+	—	+	—	—	+
D.....	±	+	+	+	+	—	++	—	—	++
E.....	—	±	+	+	+	—	±	—	—	+
F.....	—	±	+	+	+	—	—	—	—	±

* The designation of patient is the same as that used in earlier papers on yaws: see Philip. Jour. Sci. 22 (1923) 219-285.

TABLE 5.—Showing the progress of globulin precipitation and the Wassermann reaction in yaws during the course and treatment of the disease—Continued.

Name.*	March 21.									
	Globulin precipitation reaction.					Wassermann reaction.				
	1:1	1:2	1:3	1:4	1:5	Alc. ant.		Ser. con.	Chol. ant.	
						1/5	1/10		1/5	1/10
A.....	—	—	+	+	+	—	+	—	—	++
B.....	—	—	+	+	+	—	±	—	—	++
C.....	—	—	+	+	+	—	+	—	—	+
D.....	±	+	+	+	+	—	++	—	—	++
E.....	—	—	+	+	+	—	+	—	—	++
F.....	—	—	+	+	+	—	±	—	—	+

Name.*	March 30.									
	Globulin precipitation reaction.					Wassermann reaction.				
	1:1	1:2	1:3	1:4	1:5	Alc. ant.		Ser. con.	Chol. ant.	
						1/5	1/10		1/5	1/10
A.....	—	+	+	+	+	—	+++	—	+	++++
B.....	—	±	+	+	+	—	++	—	—	+++
C.....	0	0	0	0	0	0	0	0	0	0
D.....	0	0	0	0	0	0	0	0	0	0
E.....	0	0	0	0	0	0	0	0	0	0
F.....	0	0	0	0	0	0	0	0	0	0

Name.*	April 6.									
	Globulin precipitation reaction.					Wassermann reaction.				
	1:1	1:2	1:3	1:4	1:5	Alc. ant.		Ser. con.	Chol. ant.	
						1/5	1/10		1/5	1/10
A.....	0	0	0	0	0	0	0	0	0	0
B.....	0	0	0	0	0	0	0	0	0	0
C.....	—	+	+	+	+	—	++	—	—	++
D.....	—	+	+	+	+	—	++	—	—	++
E.....	—	—	+	+	+	—	++	—	—	++
F.....	0	0	0	0	0	0	0	0	0	0

* The designation of patient is the same as that used in earlier papers on yaws; see Philip. Journ. Sci. 22 (1923) 219-235.

TABLE 5.—Showing the progress of globulin precipitation and the Wassermann reaction in yaws during the course and treatment of the disease—Continued.

Name. ^a	April 15.									
	Globulin precipitation reaction.					Wassermann reaction.				
	1:1	1:2	1:3	1:4	1:5	Aic. ant.		Ser. con.	Chol. ant.	
						1/5	1/10	1/10	1/5	1/10
A.....	—	±	+	+	+	—	—	—	—	—
B.....	—	+	+	+	+	—	—	—	—	++
C.....	—	+	+	+	+	—	++	—	—	++
D.....	+	+	+	+	+	—	+	—	—	++
E.....	—	+	+	+	+	—	+	—	—	++
F.....	0	0	0	0	0	0	0	0	0	0

Name. ^a	April 29.									
	Globulin precipitation reaction.					Wassermann reaction.				
	1:1	1:2	1:3	1:4	1:5	Aic. ant.		Ser. con.	Chol. ant.	
						1/5	1/10	1/10	1/5	1/10
A.....	—	—	+	+	+	—	—	—	—	—
B.....	—	—	+	+	+	—	—	—	—	—
C.....	±	+	+	+	+	—	—	—	—	—
D.....	—	+	+	+	+	—	—	—	—	±
E.....	—	—	+	+	+	—	—	—	—	—
F.....	—	+	+	+	+	—	+	—	—	++

Name. ^a	June 1.									
	Globulin precipitation reaction.					Wassermann reaction.				
	1:1	1:2	1:3	1:4	1:5	Aic. ant.		Ser. con.	Chol. ant.	
						1/5	1/10	1/10	1/5	1/10
A.....	—	—	+	+	+	—	—	—	—	—
B.....	^b —	—	+	+	+	—	—	—	—	±
C.....	^b —	—	—	—	+	—	—	—	—	—
D.....	^b —	—	+	+	+	—	—	—	—	—
E.....	—	—	±	+	+	—	—	—	—	—
F.....	^b —	—	+	+	+	—	—	—	—	±

^a The designation of patient is the same as that used in earlier papers on yaws; see Philip. Journ. Sci. 22 (1923) 219-285.

^b Hemolysis.

TABLE 5.—Showing the progress of globulin precipitation and the Wassermann reaction in yaws during the course and treatment of the disease—Continued.

Name.*	July 2.										Lymphad- enitis.
	Globulin precipitation reaction.					Wassermann reaction.					
	1:1	1:2	1:3	1:4	1:5	Alc. ant.		Ser. con.	Chol. ant.		
						1/5	1/10		1/10	1/5		1/10
A.....	—	—	±	+	+	—	—	—	—	—	—
B.....	—	—	—	+	+	—	—	—	—	±	—
C.....	—	—	+	+	+	—	—	—	—	—	++
D.....	—	+	+	+	+	—	—	—	—	—	++
E.....	—	—	—	±	+	—	—	—	—	—	—
F.....	—	+	+	+	+	—	—	—	—	—	++++

* The designation of patient is the same as that used in earlier papers on yaws; see Philip. Journ. Sci. 22 (1923) 219-285.

The results show that three days after the inoculation with *Treponema pertenue* took place (that is, on January 21) all gave a normal serologic picture with regard to the Wassermann reaction and the globulin precipitation test. A faint precipitate was found in the dilution of the serum with distilled water in the proportion of 1:3 in four of the six patients. This faint precipitate frequently forms on the border line of the positive dilution and redissolves on standing at room temperature for twenty-four hours. Three weeks after inoculation (February 14), the Wassermann reaction still remained negative, but the globulin precipitation reaction became pronounced in all cases in the dilution 1:3, in two cases in the dilution 1:2, and the remaining patients gave a faint precipitation in the 1:2 dilution. At that time the Wassermann reaction was still negative but it became distinctly positive in five patients (A, B, C, D, and E) on March 6, three weeks after the globulin test was found distinctly positive. On this date the sixth case (F) showed a ± Wassermann test. From this time on the Wassermann reaction became stronger, and the globulin precipitation maintained its height, with slight variations, until April 15. The treatment of patients A and B was begun on April 1 and of patients C, D, and E on April 7. Patient F did not receive treatment until May 5. Following treatment the Wassermann reaction rapidly became negative. Patient F, who had not received treatment until May 5, continued to give positive Wassermann reactions until

June 1, on which date the test showed slight inhibition of hæmolysis in the tube containing cholesterinized antigen and 1:10 complement. The decline of the positive globulin precipitation reaction following the treatment was much slower, and distinctly positive results were obtained at the time when the treated cases gave negative Wassermann tests. Indeed, three months (and more in some cases) after the Wassermann test had been found negative the globulin precipitation test showed positive results in the majority of the cases in the 1:3 dilution.

The results of these comparative successive tests before and after acquisition of yaws and during treatment are very interesting, in as much as they show that the globulin precipitation reaction in yaws will become distinctly positive in the pre-Wassermann stage; that it maintains its strength throughout the acute course of the disease; and that, though the Wassermann test becomes negative rather abruptly following specific treatment, the globulin precipitation reaction declines gradually and is distinctly positive in the post-Wassermann stage of the disease. The globulin precipitation reaction therefore in yaws as a prodromal and anamnestic reaction is more sensitive than the Wassermann reaction. The rapidity with which the cutaneous manifestations of acute yaws disappear following one or two injections of neosalvarsan created the impression that one or two injections of the specific drug are sufficient to cure a case of yaws. The results of our work show, however, that in a certain proportion of cases one or two injections are not sufficient to bring about a complete clinical and serological cure, because in a good many cases, after the cutaneous manifestations had disappeared, the Wassermann reaction still persisted. There is a striking parallelism between the persistence of the residual clinical symptoms (lymphadenitis) and the persistence after treatment of positive globulin precipitation reaction. We have here brought out evidence that, for some time at least, after the clinical and serologic (Wassermann) cure has been accomplished there is yet evidence of pathologic changes in the serum of the healed yaws patients which can be made evident by the globulin precipitation test.

Another point of interest has been brought out by repeated examination of the blood of the patients referred to in the second part of this paper. On July 2, when the patients were examined, they were found clinically normal. The cutaneous manifestation had disappeared completely and the size of the

glands was reduced to such an extent that, had we not known the previous condition of the glands, either they would have been overlooked or their slight intumescence would have been considered as due to another cause. Being familiar, however, with the clinical condition of the patients from the beginning of the infection, and considering particularly the rapid decrease in size of the glands after the specific treatment for yaws, we paid especial attention to the condition of the glands and found that in three of the six cases there still persisted a more or less pronounced adenitis. (See Table 5.) If these patients had reported for serological examination without their previous history being known the globulin precipitation reaction would have been found strongly positive in at least two, pronounced in one, and doubtful in one of the six apparently normal persons. This observation of the persistence of globulin precipitation reaction (a nonspecific reaction which may be due to any of several diseases) is of importance, in as much as difficulties may be encountered by authors using the globulin precipitation test to set a definite standard for this reaction in healthy persons. In localities where syphilis, yaws, or leprosy is prevalent there is little doubt that persons whose serum gives a positive precipitation have suffered previously with one or other of the diseases that are accompanied by positive globulin precipitation reaction. Of these diseases yaws is most likely to be misleading, due to the fact that very frequently no trace whatever is left of a yaw granuloma once it is healed, and yet, as evident from this investigation, the globulin precipitation reaction persists.

SUMMARY AND CONCLUSIONS

1. The globulin precipitation test with distilled water was found positive in at least a 1:3 dilution in every one of the twenty-four active yaws patients examined. In certain cases the reaction was very strong, in as much as precipitation occurred in as low a dilution as 1:1.

2. Healed cases of yaws showed less-pronounced precipitation than did the active cases, but a good many still gave positive reactions.

3. Both qualitatively and quantitatively the results of this test and of the Wassermann reaction did not always agree.

4. Experimental evidence is produced that the globulin of the patient's serum which precipitates upon dilution with distilled water is not the carrier of the Wassermann antibody.

5. The globulin precipitation reaction with distilled water becomes positive shortly after the infection with *Treponema pertenue* sets in and is pronounced in the "pre-Wassermann" stage. It maintains its strength throughout the course of the disease and is still positive long after the Wassermann reaction becomes negative through specific treatment. As a prodromal and anamnestic reaction in yaws the globulin precipitation reaction is more sensitive than is the Wassermann reaction.

6. The practical value of the globulin precipitation reaction as a confirmatory test of clinical diagnosis of yaws in the pre-Wassermann stage and as a useful reaction for the guidance of the extent of specific treatment necessary in a given case of yaws is strongly indicated.

7. Due to the simplicity of technic, the reaction under discussion may prove to be of value in antiyaws campaigns in locations where conditions make the carrying out of the Wassermann reaction impracticable.

A CLINICAL MODIFICATION OF YAWS OBSERVED IN PATIENTS LIVING IN MOUNTAINOUS DISTRICTS ¹

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TWO PLATES

The widespread dissemination of syphilis throughout the world is rendered possible by the fact that *Treponema pallidum* is independent of climatic conditions. The reverse is true of *Treponema pertenue*. Of the infectious diseases which have no intermediate insect host, yaws is one of the few that are limited by nature to the Tropics. When accidentally introduced into temperate zones yaws does not gain a foothold. Within the Tropics, typical cases are found for the most part only in the low warm regions. Indeed, it has come to be a textbook statement ² that the disease practically does not occur above an altitude of 800 feet (about 270 meters). An exception was noted by Ricono,³ who described eight cases in Africa occurring at an average elevation of 5,500 feet (about 1,800 meters). The clinical findings in these patients were not especially remarkable. The lesions were widely distributed over the body. Iritis was noted in two cases and condylomata like those in syphilis were present in others. Ricono states that, without any previous history, the most obvious diagnosis in three of the eight cases would have been syphilis. However, he expresses practically no doubt about the correctness of the diagnosis of yaws in the entire group.

¹ From the Philippine Health Service and the Bureau of Science, Manila.

² Castellani, A., and A. J. Chalmers, *Manual of Tropical Medicine*, 3d ed. London. Baillière, Tindall & Cox (1919) 1537.

³ *South African Med. Rec.* 14 (1916) 83.

Oho⁴ describes an isolated endemic focus of yaws in the mountains of Formosa at an altitude of about 5,000 feet. He noted typical skin lesions, and the diagnosis of yaws was confirmed by histological section.

Mattlet⁵ reports that yaws is abundantly present in the mountainous regions of Kitega, in Africa, the elevation varying from about 5,200 to 6,600 feet (1,600 to 2,000 meters). He emphasizes the tertiary lesions of the adults resulting in deformities of the long bones, ankylosis of the joints, erosion of the mucous membranes, and destruction of the bones of the face.

Gilks,⁶ in the treatment of more than thirty thousand cases of yaws in the Kenya Colony in East Africa, noted that many cases occurred at altitudes of 5,000 feet, but he observed that the disease was particularly prevalent in some of the warmer, low-lying localities. No description is given of the clinical symptoms of the patients observed at high altitudes.

In the heavily populated Dutch East Indies there are many hundred thousands of yaws cases. Winkel⁷ mentions some interesting points in the distribution of these patients. In Java the disease is prevalent in the low countries and its incidence decreases gradually in proportion to the altitude; it is absent in the plateaus, even in districts where the natives are very uncleanly in their habits. On the contrary, in Sumatra many cases are found at a height of 3,000 feet, an elevation much greater than the plateaus of Java. Winkel's report is not concerned in any way with the clinical symptoms of the patients.

In Ceylon, Bahr⁸ found that yaws, though prevalent in the lowlands, was extremely rare above an altitude of 800 feet. Although yaws has now been reported from fairly high altitudes in widely separated parts of the tropical world, it seems clear that the disease flourishes characteristically in the low-lying warm districts, preferably within at least a few hundred feet of sea level.

We have recently observed some cases of yaws showing interesting clinical modifications. In the Philippines, in the mountains of northern Luzon, there is an extremely interesting group

⁴Trans. Fourth Congress Far Eastern Assoc. Trop. Med. 2 (1921) 138.

⁵Ann. de la Soc. Belge de la Med. Trop. 2 (1922) 156.

⁶Trans. Roy. Soc. Trop. Med. & Hyg. 17 (1923) 277.

⁷Meded. v. d. Burgerlijken Geneesk. Dienst in Nederl. Ind., Part 3 (1923) 213.

⁸Ann. Trop. Med. & Parasitol. 8 (1914-1915) 675.

of people. They are probably of ancient Malay origin, but they now live in the mountains quite apart from the inhabitants of the lowlands and have developed their own dialect, mode of dress, and social customs. Yaws is prevalent in Ifugao Sub-province, and the cases there are typical of the disease as it occurs in Mountain Province. At Kiangán, in Ifugao, Dr. Rafael Jagunap of the Philippine Health Service requested the yaws patients in the vicinity to report for treatment. Twenty-eight presented themselves; these, together with five others already under treatment in the hospital, form the basis of this report.

DISTRIBUTION OF LESIONS

The patients showed involvement of the muco-cutaneous junctures around the mouth, the nose, the anus, and the genitalia. It was practically impossible from the history to determine the location of the primary lesion.

Of the thirty-three patients seen in Kiangán, seventeen were children between the ages of 2 and 13 years, and the remainder were adults. Lesions of the anus or genitalia were noted in twenty-nine cases, and of these ten showed no involvement of the mouth or the nose. Not infrequently the anus alone was involved, but in female patients it seemed only a question of time for the infection to spread to the vulva. There were twenty-two cases, in all, showing lesions of the mouth or nose, and in four of these neither the anus nor the genitalia were as yet involved.

Occasionally the infection extends to the immediately adjacent areas by direct continuity (Plate 1, fig. 1.), or by direct contact, but usually the disease runs its entire course without any generalized development of granulomata over the body.

Only five of the thirty-three cases showed any evidence of metastatic involvement of the skin in areas more or less remote from the muco-cutaneous lesions. One of these five had a few papules over the bridge of the nose (Plate 1, fig. 2); a second had granulomata in one axilla; a third showed macular lesions in the palms of both hands (Plate 1, figs. 3 and 4); a fourth had papules over the eyebrows and on the scalp; a fifth case showed two granulomata on the right fore arm, one on the left shoulder, and several in the palms. The contrast between the typical cases of the mountains and those of the lowlands is shown in Plates 1 and 2.

During the years 1923 and 1924, Dr. Francisco Gomez and Dr. Rafael Jagunap treated two hundred twenty-two cases of

yaws in Mountain Province; one hundred twelve of these patients were children and one hundred ten were adults. Of the entire group, only nineteen showed any metastatic lesions.

CHARACTER OF LESIONS

The general appearance of the lesions around the muco-cutaneous junctures is shown in the accompanying illustrations. Clinically they look suspiciously like syphilitic condylomata, and they have occasionally been diagnosed as such. They do not conform to *granuloma inguinale*. Six typical cases were tested for the Wassermann reaction and complete fixation occurred in each instance. In another case, practically cured by treatment, the reaction was moderately strong (++) . There is no doubt in our own minds that these lesions are due to yaws. These patients do not show any manifestations peculiar to syphilis. Moreover, in three cases of this group typical granulomata were found, either near these condylomalike lesions or on remote parts of the body.

The result of animal inoculation is consistent with the diagnosis of yaws. A patient was selected who showed condyloma-like lesions around the mouth and anus, but no typical granulomata. Scrapings from these lesions were suspended in saline and injected intradermally in the eyebrows of three young monkeys (*Pithecus philippinensis*). In one of these animals lesions developed after five weeks which, clinically, were suggestive of yaws. The usual treponemata were seen on examination with the dark field.

The extensive involvement of the genitalia might readily suggest sexual transmission and, indeed, some patients gave a more or less definite history of having contracted the disease in this manner; but, at most, this can only be an accessory mode of transmission for in the mountains, as in the lowlands, the infection is prevalent among children. Tertiary manifestations appear to be rare. Dr. R. Jagunap during the course of two years of duty in Ifugao could recall only one patient in whom the nasal lesions progressed to the destructive stage of rhinopharyngitis mutilans—that is, gangosa. Dr. F. Gomez, during two years of service, found six cases of gangosa in the remote districts of Ifugao.

According to the vague accounts of the patients, untreated cases usually regress spontaneously within about one year. The native chiefs state that yaws has existed in the mountains from time immemorial. Their local name for it, "gang-a-gang," is totally unlike any of the names used in any other part of the Philippines. The disease is certainly endemic in Mountain Province, for there is no contact with the distant yaws centers in the lowlands, the nearest one of importance being 150 kilometers away, in Ilocos Sur. There is an absolute minimum of communication between the mountain tribes and the Christian Filipinos of the lowlands. Indeed, within Mountain Province among people of their own tribe, natives steadfastly refuse to go more than a short day's journey (30 kilometers) from their own homes.

LIMITATION OF THE SKIN MANIFESTATIONS

The infection is not restricted to the muco-cutaneous lesions, because the lymphatic glands, the inguinals, the epitrochlears, the axillary, and the posterior cervicals and auriculars are definitely and sometimes enormously enlarged in a typically indolent fashion. The limitation of the skin lesions to the muco-cutaneous orifices of the body is inexplicable at present. The first factor for consideration is the question of clothing and climate. The men and boys wear nothing but a breechcloth; the women wrap a broad piece of cloth loosely around the loins, giving little protection from the cold. The principal occupation of the natives is working in the rice terraces.

We have observed cases of yaws at elevations varying from 600 to 2,100 meters but the average altitude at which the majority of the patients live may be roughly estimated at 800 to 1,200 meters. The effect of altitude upon the climate of this region is particularly noticeable in the minimum temperatures. No climatological data are available for Kiangnan, but Bokod, a typical station in Mountain Province, at an elevation of 900 meters, may be suitably compared with Manila, situated on the shores of Manila Bay. The records of the monthly temperatures for these two stations, presented in Table 1, were supplied through the kindness of Father Miguel Selga, acting director of the Weather Bureau.

TABLE 1.—Comparison of the extreme monthly temperatures of typical stations in Mountain Province (Bokod, 2,800 feet elevation) and in the lowlands (Manila), calculated for the three-year period from 1922 to 1924.

AVERAGE MAXIMUM TEMPERATURE °C.

Station.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Bokod...	28.0	29.4	30.7	31.3	30.4	28.8	27.8	26.3	27.9	27.4	28.1	28.3
Manila...	30.4	31.7	32.3	34.8	33.6	31.9	30.8	30.4	31.2	31.3	30.5	30.1

AVERAGE MINIMUM TEMPERATURE °C.

Bokod...	13.9	14.4	15.8	16.8	17.2	18.2	18.6	18.5	18.1	16.7	16.2	15.5
Manila...	20.5	20.7	21.2	22.6	23.9	24.2	23.8	24.0	23.8	23.0	22.4	21.4

This difference in temperature, though not extreme, is of some significance. Even in the continuous warmth of the lowlands the granulomata of yaws show a definite predilection for the protection afforded by the warm moist areas of the body. If it should be proven eventually that low temperature is an important factor in limiting the spread of the granulomata over the body, then it is all the more interesting that a drop of a comparatively few degrees should be sufficient to effect this limitation. Reports from various parts of the world show considerable variation in the ease with which yaws established itself in mountainous districts of similar elevation. Aside from the question of temperature, the amount of rainfall and the degree of humidity may exert some influence, since yaws is characteristically a disease of warm moist countries rather than of arid regions. As already mentioned, Winkel has reported that yaws is prevalent in the high plateaus of Sumatra, but absent in corresponding altitudes of Java. The high mountains of Sumatra are wet throughout the year, and the contrast with Java, particularly with East Java, is very noticeable in the vegetation.⁹ However, it is obvious, that the information concerning the climate and the distribution of yaws in the Dutch East Indies is not sufficiently complete to permit any definite conclusions being drawn therefrom.

On hypothetical grounds we may consider that a special strain of yaws of low dermatotropic affinity has developed in these

⁹Braak, C., *The Climate of the Netherlands Indies* 1st. English Summary, page 17.

tribes in Ifugao, cut off for centuries from communication with the outside world. At present there is no evidence to support such a supposition. If such a strain exists, it has not spread to the lowlands in the Philippines. We have not yet been able to perform the obvious and apparently simple experiment of inducing some of these patients in the early stage of the disease to leave the mountains and live for a few weeks in the lowlands. This would afford the advantage of a favorable climate for permitting the granulomata to appear on various parts of the body.

SUMMARY

Yaws is widespread in the mountains of northern Luzon, at elevations varying from approximately 600 to 2,100 meters. The disease is endemic in the mountains and propagates itself independently of any communication with inhabitants from the yaws centers of the lowlands.

Clinically, the yaws cases that occur in the mountains show a striking peculiarity in that the cutaneous lesions in the majority of the patients (90 per cent) are limited to the muco-cutaneous junctures of the mouth, nose, anus, and genitalia. The explanation for this modification in the distribution of the skin lesions is not evident. Systemic distribution of the treponemata in these patients is indicated by the generalized enlargement of the lymphatic glands.

ILLUSTRATIONS

PLATE 1. CASES OF YAWS FROM MOUNTAIN PROVINCE, LUZON

- FIGS. 1 and 2. Lesions of the mouth, nose, and chin.
3 and 4. Case showing palmar framboeside.
5 and 6. Lesions of the anus.

PLATE 2

- FIGS. 1 and 2. Cases of yaws from Mountain Province.
3 and 4. A case of yaws from Parañaque, showing generalized distribution of the granulomata characteristic of patients in the lowlands.

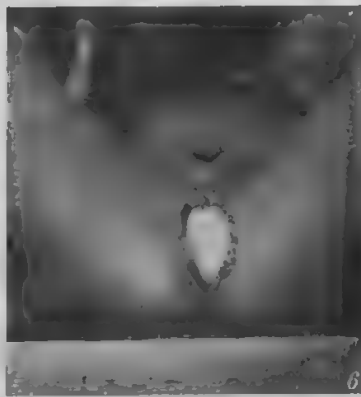


PLATE I.



PLATE 2

ERRATUM

Vol. 29, page 392, for lines 1 to 5 substitute—
Elaeocarpus pedunculatus Wall. *

Elaeocarpus pedunculatus Wall.; MERR., Enum. Born. Pl. (1921) 371.

No. 1739, from Balambangan Island, in forests. Malay Peninsula, Penang, Singapore, and Borneo.

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[New generic and specific names and new combinations are printed in clarendon; synonyms and names of species incidentally mentioned in the text are printed in *italic*.]

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